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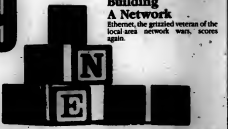
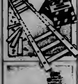
Dial-in means Digital Pathways.

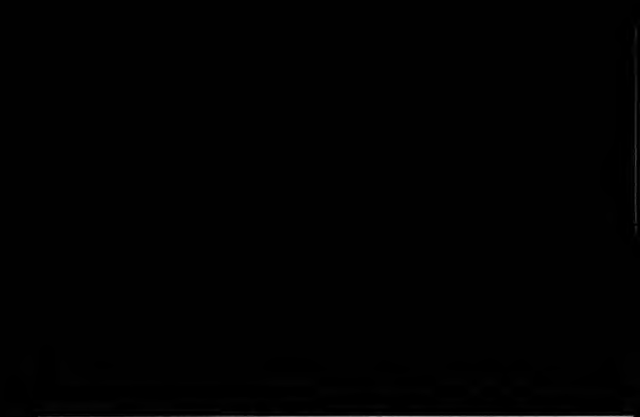
CONTENTS



Special Section: Digitizing America



DEPARTMENTS



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	DDCMP	X 25	Ethernet
Physical	Physical Link		

EDITORIAL

Training Lags the Field?

The deplorable state of telecommunications education and training in the U.S. is something of a mystery.

At a time when the industry is experiencing unprecedented turmoil and the demand for trained telecommunications professionals is at its peak, the educational response has been at a nadir.

Even more odd is the fact that the efforts by some to advance the underwhelming state of education and training have met with scorn. One industry "expert" criticized the nascent certificate in telecommunications being offered by New York University because it is not turning out engineers.

Why is it that both the supply of professionals as well as the number of training sources are so low today?

One obvious answer is that change comes slowly. Even if universities nationwide were to implement comprehensive telecommunications programs, the first graduates would not be on the streets for at least two years. But there is no solid evidence to indicate that this kind of necessary curriculum is being implemented, even on a scattershot basis.

Again, why not?

Maybe it has something to do with vested interests, in both the academic and professional arenas. Computer science degree programs have not been around that long, and their emphasis has been on preparing students for a career on the computer, not the communications side of the house.

Could it be that computer science faculties are reluctant to admit theirs is no longer the only domain of importance? Perhaps college administrators should take a good hard look to make sure that this is not the case.

On the professional front, telecommunications has long taken a back seat to corporate computing. This is only natural, because only recently has telecommunications achieved such prominence and importance. Now, however, it is time for companies to realize that they will be cutting off their noses to spite their faces if they continue to relegate telecommunications and telecommunications training to a back seat.

Just as college administrators must shape up their curricula, top management must promote a companywide awareness of the importance of training. Telecommunications is no longer an expense, but a corporate weapon.

Those who do not use it will have it used against them.

Computerworld

On Communications

Don't question your vision if the November issue of *On Communications* looks different next month. We are making some big changes, and one of them involves our name.

From Nov. 7 on, we will be known as *On Communications* instead of *Computerworld On Communications*. Although the name will change, the editorial content and quality will not. We are retaining our basic commitment to bring you all the information you need in the rapidly changing world of communications. And we are still a member of the *Computerworld* family.

Change will also come in the form of a new monthly column on technology written by William F. Zachmann, vice-president, corporate research, with International Data Corp.

We will be bringing our message to a lot of new readers, and that is another change. However, if you have not filled out one of the qualification cards we have inserted in all our recent issues, you will not be one of them. So fill out the card and send it in now.

We are looking forward to bringing our first issue of *On Communications* to you in November.

Computerworld
On Communications

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DIALOGUE

Is your firm affected by the increasing presence of digital transmission?

Tony Nuzzetti, North American sales operations supervisor, Fairchild Camera and Instrument Corp., Mountain View, Calif.:

"We have six multipoint digital lines across the U.S., and we use digital transmission in all of them. It is a much better grade of data communications than analog. You also have one point of contact, so when you have trouble, within 20 minutes you know where your problem lies."

Larry Marks, data network manager, Tandem Computers, Inc., Cupertino, Calif.:

"Digital transmission has been getting cheaper. The more the traditional modem manufacturing companies come out with those terminating devices on the lines, the more cost-effective these circuits will be. They are not very cost-effective right now because the termination devices provided by AT&T are significantly more expensive than equivalent analog circuits.

"They are probably more reliable, though, in that they should break less, but we have no evidence of that yet — that is, not the terminating equipment, but the lines themselves. They do seem to have better characteristics with respect to error rates, so we are very interested in them. But we are also interested in packet networks.

"Given a choice between analog, digital and packet networks, if they were all priced the same, I would go to packet networks. There are still some barriers to digital. Right now, there is a lack of digital tails — the circuits that run from the telephone central offices to the customer premises — in a number of locations. If you want to sum it up, I am not wildly excited."

John Joy, data processing manager, city of Portland, Maine:

"After the reconstruction of our public safety building, where the fire and police headquarters are located, we installed in the street our own private conduit between this building and City Hall.

"We installed our own wire to eliminate the need to rent a phone circuit from the telephone company. We do all our own digital transmission over our own private line."

Gene Doucette, telecommunications analyst, Hewlett-Packard Co., Palo Alto, Calif.:

"In the case of data communications, we have some Dataphone Digital Service lines from our centralized computer system here to the Washington, D.C., area and to Spokane, Wash.

"Our experience with these digital lines has been very good as far as error rate is concerned. The bit error rate on these lines is far, far lower than on analog lines. We are probably seeing half the errors we would see on analog facilities.

"The prime advantages of digital transmission are lower error rates and, in the case of voice, better voice signal quality. Digital transmission has been in existence for many years with message telephone service, and it is becoming a larger portion of the overall Bell System."

LETTERS

Home on the Farm?

To the Editor:

Whoever chose the landscapes containing saguaro cacti for use with an article on Wyoming needs a vacation — part of the vacation to be spent here in Wyoming to see what our state looks like and part to be spent in Arizona and New Mexico to see where the saguaro cacti do grow.

And I believe that in all probability, Mr. Adams lives on a 1,000-acre *ranch*, not farm.

Lowell Ray Anderson
Cody, Wyo.

Editor's note: We'll take the vacation, but in all deference to John Q. Adams, be insists that be lives on a 1,000-acre farm, *not ranch. He told our reporter: "Everyone wants the romance of being known as a rancher even if they have four or five acres. They tell me in California it is worse, that anyone who has an acre has got a* ranch. *This land here is a* farm."

On Communications welcomes letters from its readers. Letters should be typed, double-spaced and no longer than 150 words. They should be addressed to *Editor, Computerworld On Communications, 375 Cochituate Road, Box 880, Framingham, Mass. 01701.*

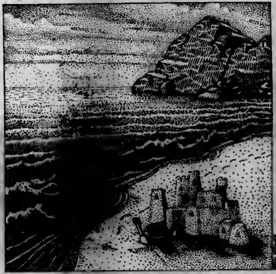
PRO & CON

Is Digital the Wave of the Future?

This month's special section, "Digitizing America," is testament to the fact that the digital revolution is transforming the nation's communications landscape. The advent of such celebrated technological innovations as integrated services digital networks is making it clear that we are headed toward a digital future.

But will it be an all-digital future? Analog technology has been the staple of the U.S. national communications network since it was born, early in the 20th century. The analog loops provided by local telephone companies are the backbone of metropolitan communications, and they still maintain a pervasive presence. Furthermore, many companies are not anxious to convert their perfectly workable analog systems to digital. The axiom, "If it's not broken, don't fix it," still packs a lot of punch with communications planners.

In this month's "Pro & Con," we present one argument for the perpetuation of analog technology and another argument for the move to digital.



PRO

By Stephen Hester

Digital technology is all around us. Digital watches tell us the time. Digital recordings and players bring us the ultimate in high fidelity. And the controls on many televisions, radios and even cars are now digital.

Perhaps most important, the digital world of telecommunications is all around us, too, and its size and importance are growing daily.

Driven in part by digital technologies, the U.S. is quickly entering a new era. While analog communications was sufficient for an earlier, precomputer era in which voice communications dominated, a new communications infrastructure is needed in an age in which information is the key commodity.

Digital technologies provide the needed technological leap forward and offer the means to fulfill the promise of this new information-intensive age.

Historically, separate facilities have been needed for handling different kinds of signals, such as voice, data or video, each optimized separately. Today, whatever the form of the input — and whatever the desired form of the output — the information can be conveyed end-to-end on an integrated digital network. And in replacing separate — often duplicate — facilities, such a system offers both economic and technological advantages. The great technological advantage of digital communications is the ability to transform any kind of information into a common code, compact it, route it or switch it and move it over great distances with virtually no noise or distortion.

One economic edge comes when the cost of digital components declines to the point where they are cheaper than conventional analog technologies and when enough systems employ digital communications to achieve economies of scale. Another economy comes from not having to transform the signal to switch or transmit it. And the considerably greater accuracy of transmission innate in digital regeneration adds yet more efficiencies.

With today's phenomenal advances in semiconductors and integrated circuits, the first economy already has been achieved. For example, two of these semiconductor chips, no larger than a penny and costing less than $10, can form the heart of a computer equivalent to a 1955 machine bigger than a bus and costing hundreds of thousands of dollars.

With the commitment of major suppliers like Northern Telecom, Inc. to fully digital communications sytems, the second economy is also being realized.

The large firms were the first to
(Continued on Page 10)

Hester is vice-president, sales, Bell operating companies, Northern Telecom, Inc., Research Triangle Park, N.C.

CON

By Gary T. Bartoo

Digital data service is a lot like the Goodyear Blimp — it maintains a significant presence without having a lot of substance. And although everyone is familiar with it, it actually makes its appearance in relatively few places.

We are entering an era that has been termed communications-intensive. A decade ago, we were focused on the modern miracles of data processing. But while the information was being processed with lightning speed, it seemed to be communicated by the proverbial slow boat to China.

DP is being applied much more routinely now, but there is a greater awareness of the requirements of communications. It has finally been realized that the value of information is often directly proportional to the ability to communicate it. The imperative to communicate is also relative. Some companies, because of size, resources or management style, use computers sparingly. For them, there is no burning question of whether to adopt digital service.

But at Metroteller Systems, Inc., we weighed and evaluated the question. Metroteller Systems is a communications-intensive company. It is one of the country's largest providers of electronics funds transfer services, supporting 400 automatic teller machines and point-of-service terminals located in New York, Rhode Island, Maryland, West Virginia, Michigan and Massachusetts. Its client base is comprised of savings banks, savings and loan institutions, commercial banks and credit unions.

Metroteller provides a service at a reasonable cost and ensures that this service will be available to customers when they need it. Its network handles an average of 800,000 transactions per month, and it is on line 24 hours a day, transmitting data over 60 leased analog lines. There are no digital circuits in Metroteller's network.

Metroteller strives to keep costs down for customers. Controlling communications costs is probably one of the biggest challenges any organization with an on-line network can have. At Metroteller, cost-efficiency is imperative.

Naturally, one of the first advantages of digital circuits is economics. We discussed that digital data service generally costs as much as, or more than, analog service. But even attractive pricing does not amount to much when you cannot get the product. AT&T's long-range plans are to convert to digital facilities in order to increase the available bandwidth capacity. But by AT&T's projections, long-haul circuits will still be 70% analog through 1988. Digital circuits may be a solution to capacity problems in the future, but now, they are part of the problem. Currently, an analog circuit can be ordered and installed in a few months, but a digital data service line ordered today will not be available until next year. That is hardly conducive to rapid growth and expansion.

The cost of implementation is another offsetting consideration. Major changes in a network are seldom inexpensive, and they are invariably inconvenient to users. That is why network planners strive for network designs that provide the most flexibility for growth and change.

Most data communications managers want simplicity — to streamline and stabilize their operation for maximum efficiency. That means weighing the temporary disruption and implementation cost against the anticipated advantages. Introducing digital data service into our network would be disruptive and expensive. Putting in a new circuit, after all, is not like trying out a new modem. You do not just get a few test units and run them in the back room for a while until you are satisfied that they work.
(Continued on Page 11)

Bartoo is assistant vice-president, computer operations, Metroteller Systems, Inc., Buffalo, N.Y.

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Touch Tone is a trademark of AT&T.

PRO *(From Page 7)*
recognize the value of being able to handle economically diverse information over a common network. Over the past decade, their orders for digital equipment have driven the industry so far forward that there is no longer any thought of turning back.

With information management now a strategic concern of business, private networks have led the way to the new digital reality. Private networks using microwave, satellite, T-1 carrier or fiber optics all rely on digital technology. And increasingly, organizations are installing digital private branch exchanges (PBX) to take advantage of the cost efficiencies and communications advantages offered by a PBX that can switch data as easily as it handles voice communications.

The expanded capabilities of a digital PBX and digital networks are especially important as organizations seek to integrate desktop computers with mainframe systems, process and move text from one workstation to another and handle worldwide voice communications. Already, analog electronic PBXs are being replaced with digital ones — a cycle expected to fuel the digital PBX market for much of this decade.

In the U.S. public telecommunications network, digital is also the order of the day. Virtually all new long-haul transmission links are digital, as are all new central office installations. To handle increased traffic volumes more efficiently and provide entirely new subscriber services, telephone companies are unanimously choosing digital systems.

In its central office industry analysis, Northern Business Information, Inc., of New York, estimated that the number of digital lines installed, including line and feature additions, will increase from two million lines in 1983 to as many as 7½ million lines of digital equipment installed in 1987. In addition, demand for analog systems will drop. Northern Business estimated that while six million lines — new and additions — of analog equipment were installed in 1983, the number will fall to about two million this year. The analysis noted that, with few exceptions, only additions will be installed in the future.

Northern Telecom's leadership in digital communications is reflected in its contracts with all the Bell operating companies and all major independent telephone companies to provide digital switching and transmission equipment. Other suppliers have acknowledged the inevitability of a digital future by offering their own digital products to the world market. The list of vendors reads like a "Who's Who" of telecommunications, including AT&T, ITT, GTE Telenet Communications Corp., Ericsson Information Systems and many others.

It is also apparent that the world is following America's lead. A market study by James Capel and Co., a London securities firm, reported that 35% of the worldwide central office equipment market is digital, and the percentage is growing at 6% to 7% a year as countries everywhere upgrade their telephone systems.

The UK, for example, is moving quickly to make its public telephone network fully digital, with the intention of expanding data, text, facsimile and graphics services available through British Telecom, the national telephone service.

The vision of the future is the integrated services digital network (ISDN), in which digital communications is the common denominator for virtually all forms of information transfer.

ISDN will provide a common, compatible, cost-effective architecture for handling any kind of information — spoken, visual, written or recorded. Scientists, governments and businesses worldwide have focused their resources on ISDN. While not all the issues have been resolved, an integrated solution based on digital technology is the common goal. And, day by day, it is being realized.

Why are the U.S. and the world turning digital? Digital communications offers an opportunity to do more and to do it faster and cheaper and better than ever before. On one hand, we are seeing information volumes increase exponentially. On the other hand, unit costs are rapidly declining in the semiconductor and computer industries. The result is an upward spiral, with momentum building in favor of digital technology.

The applications of digital technology are everywhere. And in telecommunications, the digital world — a phrase coined by Northern Telecom to represent its concept of the totally digital network of the future — is becoming a reality.

As more and more users and suppliers turn to digital communications, there will no longer be a choice between digital and analog. The world will be digital.

CON *(From Page 7)*

Even in the best case scenario, which involves a digital data service circuit as a clean addition to the network, the implementation overhead is still there. The introduction of a new medium means new hardware, new modes of operation and training personnel to use the new tool. The worst case scenario would be a line conversion, replacing an existing analog circuit with a digital circuit. To avoid disrupting service to users, I would have to set up two parallel networks for a period of time, testing the new circuit thoroughly before cutting over from the old one. The advantages must be clear-cut for a data communications manager to undertake this process. But the advantages of digital were not, in our evaluation, clear-cut at all.

Right now, I maintain four equipment vendors and deal with multiple vendors for circuits — the local telephone operating companies in the states we serve and AT&T for interlocal access and transport area circuits.

Metroteller has worked hard to establish a good rapport with the telephone companies. The diagnostic gear I have allows me to pinpoint line problems accurately. When I call the telephone company with a problem, I can not only say that we have a problem, but also describe it, which cuts down on defensiveness.

Digital data service would be a step backward at its present state. It is a relatively unfamiliar medium to the telephone company technicians with whom I deal, and I cannot do the kinds of diagnostics on digital data service that I can do on analog lines.

Control is crucial to running a network. I can monitor and test every line, every modem right out to the terminal. From the user's perspective, achieving that level of control has been a major breakthrough. Migrating to digital — and forfeiting that control — is a step backward.

We have all heard the statistics about digital data service reliability. It is fabled at over 98% uptime, so is there cause to be so concerned about that which never fails?

Metroteller checked the reliability statistics for digital data service and discovered that statistics can be deceiving. In quoting downtime statistics, AT&T does not specify whether the down periods will involve a few outages of long duration or multiple breakdowns of short duration. To me, the difference between the two is all the difference in the world.

Uptime on my present network is 99.9%, and any downtime I do incur is generally brief. With the high degree of diagnostics I have, I can practice preventive maintenance and rapid fault isolation. Sometimes users are back up before they are even aware they have been down.

AT&T reassured us that there were redundant systems, but since they are hubbed in the same location, I suspect that what disrupts one will probably affect the others. With digital data service, it is entirely possible that a line could be out for hours, even days. Not only is this type of prolonged downtime intolerable in our operation, there is no backup for digital data service, unless you maintain a completely redundant analog network just in case.

Metroteller's evaluation of digital data service showed a technology in transition, still too new and fraught with too many problems to support critical on-line applications.

It undoubtedly has its place in certain applications — supporting higher speed 56K bit/sec transmission, for example. But relative to analog transmission, digital data service is a technology moving from infancy to adolescence.

NEWS ANALYSIS

AT&T Technologies Axes 11,000 Jobs

AT&T Information Systems was the biggest loser when AT&T Technologies, Inc., the deregulated business segment of AT&T, recently decided to slim its employment base by 11,000 jobs, in an effort to control costs. The bad news was officially handed down by James E. Olson, vice-chairman of AT&T and chairman of AT&T Technologies.

It was announced that 6,000 of the 128,000 AT&T Information Systems job positions would be eliminated. That means that fewer than 6,000 current employees will actually be terminated. The positions will be eliminated through attrition, transfers and voluntary retirement. Overall, AT&T Technologies employs 255,000.

AT&T Technologies employs approximately two-thirds of AT&T's work force, but generates less than half of the parent company's revenues. Furthermore, salaries account for more than half of AT&T's total expenses. The move is seen as an effort to streamline what has been a burdensome, overweight division since the AT&T divestiture of Jan. 1 this year. So far in 1984, AT&T has reported earnings that are considerably below what it projected.

Deprived of its monopolistic hold on the telecommunications market, AT&T has obviously had trouble adapting to what has turned into a fiercely competitive marketplace. Other divisions hit by the job cuts will reduce their staffs as follows: AT&T Consumer Products, 2,000; AT&T Network Systems, 2,000; staff organizations, 1,500; and AT&T Bell Laboratories, 150 administrative positions.

However, not every division was hit by the announcement. Three groups comprising AT&T Technology Systems were unscathed. The three, Computer Systems, Federal Systems and Components & Electronic Systems, are charged with computer development. An AT&T spokesman said further staff reductions are "probable, possible" before the end of the year.

Airfone Breaks Ground

One of the last havens of the harried businessman is about to disappear. Airfone, Inc. has announced it has contracted to provide cellular air-to-ground telephone service for nine airlines flying wide-body airplanes.

A joint venture of Western Union and Goeken Communications, Airfone will provide onboard transmission equipment, key systems and computers to provide the ground-breaking service. Western Union will back the service with 50 of its ground stations and 14,000 technicians.

Telephones will be mounted on cabin walls and prompted by one of six major credit cards, including American Express, Diners Club, Master Card, Visa, Universal Air Travel Card or Carte Blanche.

Once the card is inserted, the cordless telephone handset is removed, and the caller may take it back to his seat to make the call. The credit card is released and billed upon replacement of the handset.

Although the amount was not disclosed, Airfone will pay the airlines a commission for each call.

Telex Service Dedicated To Use of Public Lines

Western Union said its new dial-up telex service will allow users to use public telephone lines instead of dedicated access lines from the Bell operating companies, as was previously required. The move will be a cost-saving one for telex customers because Bell operating company rates for those dedicated lines are scheduled to quadruple during November.

The monthly dial-up prices were announced as $15 for city users and $45 for remote users. The rates in use currently start at $54. In addition, Western Union said it will provide the required adapter, free of charge. For domestic calls, the per-minute charge will be 52 cents or 85 cents, depending on whether a Western Union station or another common carrier station is being addressed.

The dial-up service, which will be for both domestic and international use, would initially provide service at 50 bit/sec, with 110 bit/sec service planned within the next several months. Users will have the choice of using one telephone line alternately for voice and telex messages, or dedicating a line to telex.

Discovery Launches Communications Firsts

The latest space shuttle flight produced several firsts for the world of communications.

Discovery launched three satellites early last month. There is nothing new about that. However, one of them, Leasat, was the first satellite designed exclusively for space shuttle launch.

Owned and operated by Hughes Communications Services, Inc., Leasat is also the first satellite dedicated to providing communications services to the U.S. armed forces on a long-term basis.

It is the first of four Navy-leased spacecraft scheduled for launch on the space shuttle through 1985. The system, which includes ground facilities and one ground spare, will transmit data and voice signals for hundreds of mobile units of the Navy, Marine Corps, Air Force and Army.

The ground segment of the Leasat system includes Hughes Communications' Operations Control Center in Los Angeles, two movable ground stations in Guam and Norfolk, Va., and four satellite control sites in Guam, Hawaii, Stockton, Calif., and Norfolk.

There will also be a leased communications line to the Naval Space Command Operations Center in Dahlgren, Va., for coordination of all Leasat operations. The system will be used for the next generation for Naval UHF communications.

Leasat is also the first geosynchronous satellite to incorporate integral propulsion, which combines with the satellite's folding antenna to make the spacecraft more compact and thus less expensive in terms of weight and length. Perhaps most notably of all, the Leasat satellite was the first satellite ejected from the shuttle's cargo bay using a Frisbee motion.

Japanese Pick AT&T for Software Help

In a move that threatens IBM, Japan's Ministry of International Trade and Industry selected AT&T to help Japanese companies develop their own software.

Although the five-year pact, valued at $125 million, will not be finalized until December, it represents a big victory for AT&T in its increasingly hot battle for international supremacy with the world's number one computer manufacturer. AT&T's Unix operating system is said to be at the heart of the agreement, which would be carried out by a ministry-sponsored company working with AT&T and several large Japanese computer companies.

The deal calls for converting Unix for use in the Japanese language and for use with large computers. Although IBM already offers mainframe software, the Japanese are reluctant to become dependent on the firm.

More than half of U.S. software is computer-generated. In Japan, that figure is 90%. The Japanese would like to reduce that number to 20%, and this agreement is seen by many as a key to that.

Surcharge Hits Private-Line Users

Many private-line users whose circuits can access local exchange networks have absorbed a monthly $25 per line surcharge.

The surcharge, which will reportedly cost those users approximately $240 million yearly, is typically applied to a local private, or special-access, line connecting a private branch exchange (PBX) to users in remote cities. It is also applied to a special-access line connecting a PBX to a remote location within one telephone company service area, also known as a local access and transport area.

There was a 60-day grace period for the surcharge, starting from the implementation date of Aug. 25. There are exceptions. For instance, private-line users that obtain exemptions from the surcharge within 60 days after Aug. 25 will be freed from it. And those that secure exemptions after the 60-day interval will be assessed the surcharge, but will be eligible for a partial or total credit.

The Federal Communications Commission also ordered local carriers to send their private-line customers an explanation of how they can get an exemption and said interexchange carriers can act as agents for their customers in obtaining the exemptions.

AT&T planned a blanket certification covering more than half the local special-access circuits supporting its private-line services. That consists of obtaining a surcharge exemption from local telephone companies for all local special-access circuits connected to a particular interstate private-line service.

Users of such services would then automatically be exempt from the surcharge.

FCC Sparks Accunet Controversy

Controversy around Accunet, AT&T's X.25-based packet-switching network, was sparked when the Federal Communications Commission (FCC) gave the go-ahead for AT&T to implement its Accunet tariff.

The tariff, which went into effect Aug. 18, was protested strongly by Accunet competitors GTE Telenet Communications Corp., Tymnet, Inc. and IBM.

Monthly charges for Accunet run from $470 to $1,065 for a host computer port. GTE Telenet charges $600 to $2,000 for its comparable service, Telenet. Accunet provides access at 4,800 bit/sec, 9,600 bit/sec or 56K bit/sec over dedicated lines. Telenet offers service at speeds up to 4,800 bit/sec over dedicated or dial-up channels. The $2,000 price applies to 14.4K bit/sec dedicated access. Telenet recently began offering 56K bit/sec access in the $4,000 range.

The tariff seems to have succeeded on parliamentary grounds and may still be subject to an FCC inquiry. Because the FCC decided it could not just flatly reject the tariff and AT&T insisted on immediate action, the commission went ahead and approved it. It could be argued that such logic is only found among large, hidebound government agencies. Nonetheless, it prevailed.

The arguments from GTE Telenet and others were not unfamiliar. Their claim was that AT&T intends to use Accunet to cross-subsidize its other divisions, specifically AT&T Information Systems. This would be done by using Accunet within AT&T Information Systems' Net/1000 enhanced packet-switching service, which relies heavily on Accunet.

JANET CAMERON
& STEVE MOORE

Railinc on Right Track to Improve System

Shippers that transport products by rail consider trains a cost-efficient way of moving goods. But few people think of the railroad industry — especially the freight car segment — as a leader in computerized communications.

The **Association of American Railroads** (AAR) is an extraordinarily with-it trade association — on the communications side, at least. AAR's Train II is already an extremely sophisticated and efficient communications network. AAR's Railinc Corp., which was created to provide data processing and communications services for the AAR, is not resting on its laurels, however. It is on a fast track to improve the system and stay ahead of the exploding needs of its member railroads.

Railinc's current projects include putting in place an interrailroad office automation system with national data communications capabilities, implementing a disaster recovery plan and eventually being able to enhance the system's own ability to handle different types of protocols.

Train II is the guts of an upgraded national car information system for Railinc, a collector and provider of freight railroad information to major shipping lines, rail users and other shippers on domestic freight trains. Train II's facilities are comprised of a computer and communications network that follows the progress of more than two million freight cars, trailers and containers owned by an estimated 400 railroads, on their travels over 300,000 miles of track.

Among the tasks Train II performs are connection of member railroads to the AAR and message switching between members and subscribers. According to Railinc's President Henry Meetze, a recent check of the records reported more than 95,000 messages passing through the network daily, compared with an average of 4,500 daily as recently as 1980.

The challenge is that each individual railroad has its proprietary communications facilities within its territory — generally microwave. This equipment is used to pass voice and data back throughout the railroad's own territory. The data can be used on a computer-to-computer basis or to control signals. But most railroads have the need to communicate with one another. Train II facilities provide services not only for individual railroads, but for competing AAR members.

Started around 1970 with a small dial-in network of three dial-in lines, Train II is an evolution of a system that began with its predecessor, Train I. It has been enhanced into a star network joining 72 computers — mostly mainframes — and 13 remote job entry (RJE) devices maintained by individual rail lines. The star network's heartbeat is an IBM 4341 Model 2 mainframe that can record approximately 750,000 car movement transactions per day. In all, Railinc's system is composed of 12 large computers.

RJE devices gradually were replaced by mainframes. Then, smarter machines were installed on each end of the system. The result was an improvement in the system's message reliability. The next steps led to message and electronic waybill switching.

Railinc currently uses Bell leased lines, both digital and analog nonmultiplexed circuits, ranging from 2,400 to 9,600-bit/sec. In addition, there is a 56K-byte, time-division multiplexed line from Chicago to Washington, D.C., and a 9.6K-byte statistical multiplexed line from Detroit to Washington, D.C.

Railinc's ongoing improvement thrust is centered around enabling both the rail industry and its shipping customers, such as the automobile industry, grain companies and so on, to exchange more, better and different types of information in an electronic form. Meetze said, "It has to be a quid pro quo situation to induce people to accept and respond to electronic communications. It is fine for the railroads to be able to whisk freight bills electronically. But the customers have to be induced to accept freight bills in an electronic form." Further, Meetze claimed, the speed on the communications upgrade is rapid, the momentum is on-line and the grade is all downhill.

Mention the Federal Communications Commission to a group of telecommunications professionals and heads nod knowingly. Mention the **National Telecommunications and Information Administration** (NTIA), and nine times out of 10, eyes go blank. Yet the NTIA has an important influence on domestic and international telecommunications.

The NTIA's most important nonpolicy function is to act as a clearinghouse for the government's 40% chunk of the radio spectrum, which is shared by the U.S. armed forces; the Commerce, Justice and Treasury Departments; the FBI; the Secret Service; and other government entities.

Dale Hatfield, a Boulder, Colo., telecommunications consultant who was formerly deputy assistant secretary of the NTIA, described government spectrum allocation as a series of horse-trading sessions in which frequencies are traded while "all those people sit around a table and negotiate."

Communications research is another of NTIA's nonpolicy influences on telecommunications, but budget cuts under the Reagan administration have shrunk its research staff from 250 to about 80.

In the policy arena, the NTIA is viewed as more powerful internationally than domestically. NTIA's lineage began with the Rostow Committee under President Johnson, which set the stage for the Nixon administration's Office of Telecommunications Policy. Under President Carter, the Office of Telecommunications Policy was removed from the Office of the President to the Department of Commerce and renamed NTIA. Because it no longer directly represented the president, the NTIA's clout was considerably diminished. Henry Geller, who first headed the transplanted NTIA and is now director of the Washington Center for Public Policy, explained, "What the NTIA has endeavored to do in the domestic policy area is to be a catalyst. It cannot make policy; all it can do is send recommendations up to the FCC or to Congress."

Internationally, however, the NTIA is a major player. It represents the U.S. in global forums like the General Agreement on Tariffs and Trade and the International Telecommunications Union.

Past jealousies between the NTIA and the FCC with regard to domestic telecommunications policy have cooled in recent years, but a new turf war has kindled between the NTIA and the State Department over international telecommunications policy — a war some observers say is based on a personality conflict between current NTIA chief David Markey and Diana Lady Dougan, the State Department's coordinator for international communications and information policy.

Jurisdictional battles among the multiplicity of agencies jointly responsible for U.S. telecommunications policy periodically lead to suggestions that a Department of Telecommunications be formed.

Geller, however, said, "It is too small, and no one will do that.The problem is that the president doesn't want it back in there; the White House is trying to reduce staff, and I doubt they will put it back."

The NTIA's public visibility is certain to increase over the years as its activities in information and telecommunications policy affect more and more people.

For now, it can operate behind the scene domestically, and in Hatfield's view, that can be an advantage. "On the Hill, being visible is not necessarily the best way to work," he said. "If you are the advisor to the chairman of General Motors [Corp.], do you make policy? No. But by defining what the options are, examining the pros and cons and working closely with him in your area of expertise, your judgments influence his decisions."

Cameron and Moore are On Communications' *senior writers.*

BOCs Ask for Trouble; Greene Delivers

Two of U.S. Federal District Court Judge Harold Greene's four rules that the regional Bell operating companies must agree to before they can enter new businesses appear to be — at least at first glance — arbitrary and capricious.

They become significantly less capricious, however, when one considers that the regional Bell operating companies could hardly wait to abolish the line of business restrictions imposed on them on Jan. 1, 1984, when the old AT&T was split asunder. For them, it was a case of asking too much, too soon.

The two rules in question — that the debt and financing of new business ventures must be independent and that total revenue from competitive business granted by any waiver must not exceed 10% of the operating companies' total net revenues — may well be lifted by Greene once the operating companies have established equal access to the local network for all interexchange carriers. The rules are burdensome and will severely limit the operating companies' business activities during the next two to three years. Since the rules appear to be without precedent, they may also be appealable to the Supreme Court.

In some respects, the operating companies brought trouble on themselves. Although they feel victimized by the breakup of AT&T, which is being supervised by Greene's Federal District Court, they acted too quickly in attempting to lift the line of business restrictions imposed on them by the Modified Final Judgment. They simply have to remember that they are on probation. They are presumed to be guilty of controlling and perhaps distorting the local-access bottleneck and, therefore, have to behave themselves at least until equal access is established in 1986.

Over the long haul, however, the operating companies simply have to free themselves of the four tough rules imposed on them by Greene. These are:

■ *Separate subsidiaries.* In some respects, Greene's order has brought back into vogue the separate subsidiary concept that was popular on Capitol Hill and at the Federal Communications Commission (FCC) before the breakup of AT&T. Since the breakup, however, the FCC has only talked of "separate entities," while Greene himself imposed no separate subsidiary requirement when he allowed the operating companies to get back into the provision of customer premises equipment on Jan. 1, 1984.

Pearce is president of Information Age Economics, Inc., Washington, D.C., and a regular columnist with On Communications.

Greene brought back the separate subsidiary concept, albeit reluctantly, because he apparently saw this as the only way of measuring revenue from a particular line of business and because it makes monitoring by the Department of Justice that much easier.

The Justice Department has never abandoned its commitment to the separate subsidiary concept, so it was no surprise to hear loud applause from the antitrust division when the separate subsidiary was given a new lease on policy life by Greene.

■ *Debt and financing.* Clearly, Greene was attempting to extend the traditional definition of cross-subsidies by insisting that the debt and financing of the new business ventures be totally independent of the assets of the operating company. Most large business conglomerates, both regulated and unregulated, use their market position to raise funds at preferential rates or use funds from one line of business to finance the operations of another, newer line of business. Greene, however, is imposing a business handicap on the operating companies that is not imposed on other business enterprises.

Greene does not want to inhibit new competitors from entering the telecommunications-information market, nor does he want to erode the competitive edge of the smaller entities, the market that might be blasted out of existence by too-easy operating company entry. Thus, he is trying to create the maximum amount of competition for as long as possible.

Greene's position, vis-a-vis financing and debt, is that he wants to establish the rules whereby the maximum amount of workable competition can be encouraged.

■ *The 10% revenue cap.* Greene's guiding principle here was the protection of the telephone ratepayer, whereas his assumption in the first two conditions was the protection of workable competition. But in capping revenues at 10% of the regulated revenues, Greene may have gone too far in imposing unnecessarily burdensome constraints on the operating companies.

■ *Justice Department monitoring.* Aside from doubts about the ability — or the willingness — of the Justice Department to monitor the activities of the operating companies over the long haul, the monitoring condition is clearly a slap in the face for the FCC and the state public utility commissions.

As far as Justice is concerned, it is unlikely that the antitrust division has the necessary expertise, personnel, budget, commitment or desire to keep tabs on a dynamic, turbulent and quixotic telecommunications-information industry during the next decade or so. Nonetheless, Greene has ordered Justice — and not the expert agencies, namely the FCC and the public utility commissions — to keep abreast of developments as the operating companies mature into diversified and aggressive part-regulated, part-deregulated conglomerates.

The FCC, which has many more resources and is better qualified in these areas than the Justice Department, has had a tough time monitoring such activities during the past 50 years, so it is difficult to imagine how Justice will be able to cope.

Future strategies for the operating companies are now becoming clear, following Greene's opinion. They must implement equal access as quickly and enthusiastically as possible. They must consider changing tactics regarding local telephone bypass. In the future, they must accept local bypass as a policy fait accompli, largely because the FCC has been vigorously promoting all forms of competitive bypass for the past several years. They must consider appealing the burdensome rules imposed by Greene, namely the 10% revenue cap and the restrictions on debt and financing.

Unless the operating companies quickly embrace and implement equal access, they will never be allowed to lift the restriction on reentry into the inter-local access and transport area toll markets. Although the operating companies might not see toll services as particularly attractive, it is clear that any line of business that can conceivably be construed as offering such services will be declared illegal operating company business ventures until equal access is fully established.

Once the operating companies can prove that local telephone bypass options are operational and viable in their local exchange areas, they can go to Congress, the FCC, Greene, the Justice Department and the states for much-needed regulatory relief in order to win necessary business flexibility. They can also justify their own entry into the potentially lucrative emerging bypass markets.

Any appeal to the Supreme Court regarding Greene's burdensome rules is risky, but a conservative Supreme Court might be infinitely more sympathetic to the operating companies than a liberal judge who, while attempting to establish perfect competition or even workable competition, has decided to hobble the nation's most efficient phone companies.

Greene seems to be striving for some better model of workable competition — while at the same time protecting the telephone ratepayer — in his restriction of the operating companies. Only time will tell whether his goals can be achieved. The operating companies, on the other hand, have to live with the rules, but only for a limited period of time. There can be no excuses for the 10% cap and the debt and financing restrictions once equal access has been established and once local bypass begins to take off. Separate subsidiaries and partial Justice Department monitoring, however, may be here to stay.

corporate data base."

It is clear that the micro has taken much of the drudgery out of the modern executive's work day by automating many analytical and decision-making chores. But the micro's usefulness and the increased productivity it promised have been limited by a stumbling block. In order to use the increasingly powerful personal computer software tools available today, micro users must first manually input the necessary data — a task that can be aggravatingly time-consuming.

Thus, the micro has increased the user's thirst for rapid data access, a thirst that remains unquenched despite the vast reservoir of carefully compiled mainframe information so close at hand.

As with Coleridge's parched seafarers, micro users are marooned amid plenty. They are unable to fulfill their need for mainframe information because of the differences in data formats and the communications inefficiencies that hamper data transfers between the two dominant machine technologies of our time. Often, users are even hindered by their own corporate information suppliers — data processing and management information systems professionals — worried over the potential security hazards posed by the transfer of carefully guarded data once solely under their control.

In light of the growing need to put mainframe-based data on the desks of executive micro users, it is not surprising that the micro-to-mainframe link has become the primary focus of interest in the software industry today. The micro-to-mainframe connection has been the focus of dozens of recent trade show sessions and seminars.

The current micro-to-mainframe smoke, in the form of exaggerated marketing claims about product capabilities, has been generated from a spreading fire — a very real user need for link products. But that smoke has obscured some vital issues.

For the most part, the products now available represent an expensive and only a partial solution to the full linkage problem.

Vendors have been quick to seize on user concerns as an easy means to sell packages that have faced little real exposure in large-scale production environments. The term "link" has also been abused by marketers pushing products that offer capabilities ranging from simple hardware connectivity to terminal emulation to real bidirectional data transfer, all under the aegis of the micro-to-mainframe link.

According to IDC, the intermachine communications software currently available falls into four broad categories:

- Dumb terminal or terminal emulation systems that allow the transfer and receipt of data in the proper format for the host computer;
- Data download packages through which data from the host becomes a file stored locally in the micro;
- Information download software that transfers files structured and formatted for a specific purpose, such as use with a popular micro package like Lotus Development Corp.'s Lotus 1-2-3 or Visicorp's Visicalc;
- Active information extraction packages through which software on both the host and the micro allow a user to select specific mainframe data, usually by means of a fourth-generation query language that simplifies the data selection procedure.

Despite the wide spectrum of sophistication and functionality, products in any of the four groupings are presented to potential buyers simply as micro-to-mainframe links.

"There exists a lot of confusion about the technology," Regis Kaufman, manager of product marketing for Software International Corp., said.

"What exactly constitutes a link? Is a link an emulation package, software with file-transfer

capabilities or a system that really understands how the mainframe applications work? Users really have to sift through words to find out," Kaufman said.

"There is a real need for better communication between vendors and users. Over time, as different products are tried and users get some experience with links, a lot of the noise will disappear and some link standards will arise," he continued.

HIS COMPANY began testing the micro-to-mainframe link waters when it offered Smartlink this year. Its architecture points out yet another dividing line that separates micro-to-mainframe products on the market today.

Software International's Smartlink is a proprietary link that enables the microcomputer user to access only data stored in Software International's mainframe on-line general ledger and financial reporting system.

Examples of other proprietary architecture links include Applied Data Research, Inc.'s ADR/PC Datacom, which accesses ADR's Datacom/DB on the mainframe, and Management Science America, Inc.'s (MSA) Peachlink software that draws on MSA's mainframe applications packages. Also in that category are Computer Corp. of America's (CCA) PC/204 link to its Model 204 data base management system (DBMS) and Cullinet Software, Inc.'s Information Database system. This system provides access to Relational, which is the company's integrated DBMS.

On the flip side of the coin are the so-called open architecture products, which purport to provide micro access to a wide variety of mainframe DBMSs and file structures.

"A really open link is very difficult to deliver," Kenneth Bosomworth, the president of International Resource Development, Inc., of Norwalk, Conn., said. "It has to incorporate a variety of technically complex access methods for the vendor-specific DBMSs, and it becomes very unwieldy and complex at both ends. And, to make an open link work, you generally have to limit it to simple terminal emulation. You can only use the micro's intelligence if you have a link that really understands how the mainframe system operates."

IDC Senior Research Analyst Janice Antonellis said, "The major weakness of the micro-to-mainframe links available now is the fact that they are limited to being an interface to only one or two products in a vendor's line. Maybe there will be a gradual transition to more open links, but it seems shortsighted to interface just to proprietary software."

INCLUDED AMONG the packages boasting open architecture are products such as Micro-Tempus, Inc.'s Tempus-Link, which allows micro access to IBM's sequential file structures, IMS and DL/I and most popular DBMSs, including Cullinet's IDMS/R, Software AG of North America, Inc.'s Adabas, CCA's Model 204 and Cincom Systems, Inc.'s Total.

Infocenter Software, Inc.'s ILink and Informatics General Corp.'s Dbase/Answer and Visianswer links also fall under the open architecture heading, according to company spokesmen. Infocenter's ILink gives users the ability to draw data from a variety of widely installed DBMSs, and the Informatics products are touted as providing access to most standard DBMSs and sequential file structures.

While exhibiting open architecture on the mainframe end, Informatics' Dbase/Answer and Visianswer — marketed in conjunction with Ashton-Tate and Visicorp, respectively — fall within a

grouping of link products that provide automatic data reformatting only for specific micro software packages. Dbase/Answer reformats mainframe data for use with Ashton-Tate's micro products, and Visianswer provides automatic data reformatting for Visicorp's Visi Series. Another link in that grouping is Cullinet's Information Database, which provides reformatting capabilities for the company's Goldengate Series of micro software.

Some micro-to-mainframe link analysts complain that the product-specific reformatting approach limits a user's flexibility in choosing from and using the wide variety of micro software tools available. Other link vendors have chosen instead to provide automatic reformatting for some or all of the semistandard micro data formats in existence, such as Software Arts, Inc.'s Data Interchange Format, Ascii and Ascii text, comma-separated values and basic format. There are even link packages available that do not provide autoreformatting capabilities at all.

Some of the critical problems encumbering link technology today are the difficulties involved in data communications between the micro and the mainframe. Data transfer between the machines can be excessively time-consuming and can increase the strain on an organization's existing communications network if not carefully planned. In addition, many packages do not provide transmission restart and recovery facilities and rely instead on the facilities already inherent in the mainframe software accessed.

"The main problem with the links I have seen is in communications technology," Bosomworth said. "Almost all micro-to-mainframe links still rely on terminal emulation, and that presents a variety of difficulties in uploading and downloading data. Link communications is dominated by quick and dirty protocols with limited error checking. There have been some attempts to deal with communications errors, but they often involve retransmission of entire files or blocks of data. Transmission speed is also painfully slow."

Shaku Atre, president of Atre International Consultants, Inc., of Rye, N.Y., agreed with Bosomworth. "Link products, for the most part, only do what the communications hardware they utilize makes possible. Data extraction is not quick, especially if there are problems in transmission, and it has to be planned for. You can draw down a few mainframe records at an impulse, but not the number of data base records you need for any kind of serious microcomputer processing," she said.

Communications limitations are compounded for some link users by the problems involved in selecting from the micro end exactly which mainframe records or files will be downloaded.

Analysts complain that many link packages running on the micro require users to be familiar with mainframe logon and file-naming conventions in order to request data from DBMSs and applications — a far cry from the so-called user friendliness that the executive is accustomed to enjoying with the current generation of micro software.

"Many of the packages touted as links have very poorly designed user interfaces," Antonellis said. "They were clearly developed in a mainframe-oriented mode."

James Dickie, market manager for Informatics General's Answer series of link products, confirmed Antonellis' view. "From a user's viewpoint, future links will have to provide better capabilities for specifying exactly the mainframe data desired. We are still asking people to think logically, like programmers," he said.

The user interface of CCA's PC/204 is one that Bernard Mathaisel, principal with the management consulting firm of Temple, Barker & Sloane, Inc., said is indicative of what many prospective users would like to see in a link package. PC/204's communicator facility allows the user to access applications on the microcomputer or mainframe through a customized menu. When an application is selected, control is switched automatically to that application, letting the user bypass communications and logon procedures.

"The immaturity of the software has been a big problem," Mathaisel said. "A lot of the links require technical assistance if the user is going to get at the information he wants. The need for help flies in the face of a user who wants to do things on his own. In the future, we will look for integrated micro-to-mainframe connections that automatically handle the establishment of the link and the transfer of data."

With all the talk of downloading corporate data for local manipulation on the micro, many prospective users neglect to consider what may be a real need to update information in mainframe data bases. That real-time updating — rather than simply uploading to a separately maintained storage or buffer area — is a feature some links are not sophisticated enough to provide. Other vendors have not incorporated updating facilities in deference to some MIS manager's concerns about security.

According to Infocenter Software President Hugh Carroll, whose firm markets the ILink package, the bidirectional transfer of data is a vital capability of a true micro-to-mainframe link. "That ability brings you beyond the information center concept into the world of the information plexus, where the mainframe becomes the central repository of information generated out at the micros. We must be able to take the fruits of [an executive's] labor back up to the mainframe and not just bring data down to the micro."

Mathaisel said, "The true [bidirectional] micro-to-mainframe link implies greater productivity for both machine technologies. The micro offered powerful office capabilities and user autonomy. But micros could only be used in a stand-alone mode. The mainframe was an ivory tower not positioned for personal use. A truly functional link will allow us to employ the unique features of both to everyone's advantage."

And, while the micro threatened to usurp the MIS professional's dominance over an organization's data and computing resources, the micro-to-mainframe link may reverse that trend.

"An MIS director's political position within the company is a key factor in the implementation of a link," Bosomworth said. "The link can be useful in aggrandizing that position by making new capabilities available to others in the organization. The link can also help an MIS director avoid being bypassed by users with micros."

Software International's Kaufman agreed. "Corporate data is a resource," he said. "To leverage that, to take advantage of it, you must utilize link technology to bring resources to the people who need them."

In addition, despite the flaws that hamper the current generation of products, link technology is a newborn technology and vistas of increased capabilities lie before it. "The products are already demonstrating, step by step, that we can transfer information between the two dominant machine technologies in the industry," Mathaisel said. "Eventually, the distinctions between machines will disappear for users. They still exist, but the products allow for a basic level of connectivity." ■

Micro Links: Macro Risk

Making up-to-date corporate information accessible to microcomputer-equipped end users — the ideal of the micro-to-mainframe link — is an admirable goal, in theory. But consider the potential security risks involved in practice.

Instead of simply feeding data to a bank of host-connected terminals, you are transferring all your company's vital information resources onto user-owned diskettes, which can easily be lost, stolen or damaged. Once the data has left the mainframe, you have lost access control. If you extend to end users the capability to upload micro-manipulated data, you will position yourself for perhaps a greater security risk.

"That is a serious problem," said Philip Dorn, president of the New York-based Dorn Computer Consultants, Inc. "Downloading data is fine, but I am scared to death of uploading. It is an incredible security exposure. It is the one major reason why companies are moving slowly in the link area. It scares the hell out of me."

Dorn and other analysts contend that the development of more comprehensive security facilities is critical to wider market acceptance of micro-to-mainframe links. Many of the packages available today rely simply on the security procedures inherent in the mainframe application or data base management system accessed by the end user through the link. But some link vendors have begun to address the issue.

For example, Applied Data Research, Inc.'s ADR/Signon, for use with its ADR/PC data communications link, can be used to control user access to micro and mainframe applications. Informatics General Corp.'s Answer series of links, developed in conjunction with Visicorp and Ashton-Tate, feature DP-defined user profiles, which a spokesman said will allow a DP manager to limit end-user information access at the data base, data segment, field and value level.

On-Line Software International, Inc.'s Omnilink offers the company's Consent Access Method security system, which transparently imposes varying levels of user access control. And First Concept Technologies, Inc.'s Interchange/1 has a security system that the company said will allow the data base administrator to create templates defining micro user access to mainframe data.

A few link producers have addressed the updating problem by only allowing data uploading to a buffer or storage area. From there, information can later be transferred to live production data bases after it is reviewed by DP. But some contend that the buffer, or shadow, data base is only a partial solution to the security threat posed by updating of mainframe files.

"Having users updating live data bases from their micros is a very big concern," said Bernard Mathaisel, principal with the Lexington, Mass.-based management consulting firm Temple, Barker & Sloane, Inc. "The shadow data base is a temporary measure until we can find some way to handle micro access to production data. It is a stopgap measure that will be in place until DP can be convinced that such updating is technologically possible and can be controlled."

But despite the sophistication of any link security system, data maintained on user diskettes will still be vulnerable to loss, piracy and damage.

"Mainframe data absolutely should not be on diskettes," Shaku Atre, president of Atre International Consultants, Inc., in Rye, N.Y., said. "There are no good methods available today for protecting data on diskettes. Putting that information there is like opening up your mainframe to anyone."

— John Gallant

rather than be restricted to a specific machine. In this way, a backup service is provided if a particular resource is down. "In addition, providing access to multiple resources is important because there is always a need to share information," he said.

RECOGNIZING THE need for a communications network, Lachance formed a task force in March 1983 to define Sanders' networking requirements. The task force determined that the initial function of the network was to provide high-speed, terminal-to-host communications for engineering software development. At Sanders, most software development is supported by the VAX, so the generic interconnection of the user to any VAX was also an important requirement.

Furthermore, Sanders is a project-oriented company; each facility functions as an independent organization, with most engineering resources contained within that group.

"At Sanders, approximately 90% of engineering communications takes place within a local environment," Lachance explained, "while only 10% of communications is interfacility." For that reason, localized communications capabilities were a primary network requirement.

In addition, Sanders is a rapidly growing company, expanding its facilities to accommodate this growth. Not only was it important to minimize the cost involved in wiring a building, it was also important to find a portable solution that would allow an organization to take its network with it as it moved to new facilities.

Once the objectives of a localized, portable network were defined, the task force set out to explore the various alternatives available to the company. Sanders' first alternative was to optimize existing network tools to provide an efficient solution.

Modems were already in use between buildings, but their low speed prevented them from being an optimum form of local communications. Other options included creating terminal rooms, installing port-selectors and physically hard-wiring the terminals to each host. Each of these methods proved too expensive to be an acceptable solution.

Next, the task force considered current digital switching technologies. One option was to use the available bandwidth in a facility's telephone line with digital data switch systems. However, this technology was not easily transportable, since telephone systems tend to remain behind as people move on to new facilities.

Finally, the task force evaluated the bus topologies found in both broadband and baseband technology. Broadband offered certain strengths that the task force found appealing. It was a reliable medium, for it had been used in cable television and telecommunications for many years. It was subdivided into multiple channels that could accommodate different forms of information. However, there were limitations in its application.

The foremost limitation to a broadband network was its top-down design approach. Because analog signals are limited to unidirectional travel, a central retransmission facility, or headend, is needed to remodulate signals that have been sent on the cable into different frequency signals that can be received by the designated node.

In addition, radio frequency modems are required to convert digital signals to their desired frequency. Broadband networks necessitate careful planning: The transceiver taps introduce signal strength loss, and addition or removal of these taps affects signal quality, while the location of the headend can affect error and transmission rates.

"A broadband network does not permit easy growth, so it really limits our flexibility," Lachance said. "Furthermore, although broadband offers multiple channels, it is not a generalized data passing medium, for each channel is limited in the amount of data it can carry. If we want to allow a user to access any computer resource, we have to find a way to allow access to any channel."

A broadband network was also a proprietary network, because no specification had evolved to standardize the product. This proprietary nature locked a company into a single-vendor solution, rather than permitting the company to select individual components according to its needs. Finally, the headend itself represented a single point of failure, which increased the risk of downtime.

Not satisfied with the limitations imposed by broadband, the task force looked at baseband — the industry-standard Ethernet.

"We liked the fact that it was leading-edge technology," Lachance said. "We also found that Ethernet was the solution to our wiring problem. First, it provided us the flexibility to adapt to our changing work environment, because nodes can be installed and removed from the network without disturbing its operation.

"In addition, Ethernet's bus topology allows us to move a network from one location to another — leaving behind the low-cost cable — and reconfigure the network with considerably less effort than other alternatives explored. We liked the fact that we can take the network with us.

"We also found that baseband permits a 'design on the fly' approach," Lachance continued, "where we can build from the bottom up. Because of the ease in adding to the network and the relative lack of reconfiguration necessary, baseband allows us the flexibility to grow without an impossibly detailed long-range plan," Lachance said.

In addition, baseband was well-specified and offered Ethernet, a standardized product. Ethernet's specifications enable a multivendor network to be built, as products from different vendors can coexist on one network.

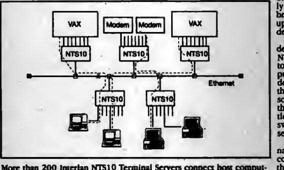
Ethernet products also provide service for RS-232 devices as well as for DEC's Decnet, which Sanders uses for interfacility and intercomputer data transfer. Ethernet's bus technology is multipurpose, in that terminal-to-host and host-to-host connections, as well as personal computer applications, can be supported (see figure above).

In addition, the passive bus provides a broadcast mechanism that allows messages to be sent to all, some or one particular node at a time. Finally, Ethernet's topology decreases the risk of network downtime, because there is no single point of failure.

In light of these advantages, the task force selected Ethernet for Sanders' local-area network in May 1983. The next six months were spent researching, testing and installing different vendors' implementations in several facilities.

In December 1983, a formal committee was established to define Sanders' networking requirements and specify a bid package for installing Ethernet products in several new facilities.

The committee described three important services that the corporation required. The most immediate requirement was RS-232 compatibility; Sanders had made a significant investment in RS-232 devices.



More than 200 Interlan NTS10 Terminal Servers connect host computers, terminals, personal computers and modems to Ethernet.

Network management tools were also important for problem isolation and network control. Finally, interfacility communications abilities were desirable in the future, as information sharing across the corporation continued to increase.

"In selecting a local-area network vendor, we looked at the total picture, rather than focusing on one decision factor," Lachance said. "First, we wanted a state-of-the-art solution to our networking requirements. We evaluated Interlan's Ethernet implementation and found that the NTS10 terminal server offered advanced technical features. It was also important that the vendor demonstrate willingness to work with Sanders throughout the entire network installation."

Interlan's NTS10 terminal server is an integral part of each Ethernet network, allowing more than 1,000 users in four separate facilities to access the computing power of a dozen VAXs and several other host computers. Specifically, the NTS10 acts as a data private branch exchange for any mix of up to eight asynchronous RS-232 devices connected to it.

By electronically connecting devices with a virtual circuit, the NTS10 allows users conveniently to access and share any host computer, personal computer, modem or other RS-232 device on the network, regardless of that resource's location. In addition to these resource-sharing capabilities, the NTS10 also offers port-switching and port-contention services.

Sanders uses the NTS10 terminal server to handle interfacility communications as well. Although Decnet provides the high-speed file transfer necessary between buildings, the current implementation is not well-suited to heavy terminal traffic. The NTS10, especially designed to handle intensive terminal requirements, forms a good complement to Decnet's capabilities.

The coexistence of Decnet and the NTS10 on the Ethernet network allows the company to obtain the high-speed file transfer it requires, while providing the corporation's terminal users with the services they need. As the corporation's communications network continues to expand, greater emphasis will be placed on interfacility communications. Currently, autodial modems and T-1 lines connect one distant facility to another, but internet routers will be used in the future as information sharing between facilities increases.

"We feel comfortable with the decisions we have made," Lachance said. "Ethernet has provided us with the flexibility and the level of service that we expected, while the terminal server products have allowed us to maximize our computer resources and realize the benefits of a local-area network. We feel we have made a solid investment with Ethernet." ■

ROCK-SOLID OFFICE ARCHITECTURE

BY ROB CORDELL

You just spent another sleepless night wondering if the contract made it to the West Coast on time. Your secretary cannot find the memo that was filed last week. And the electronic document you received turned into alphabet soup when you printed it. Sound familiar?

With diverse office systems offering different capabilities to meet the needs of many users, these can be genuine problems. One objective of office systems is to allow dissimilar products to exchange information in a universally understandable manner.

In order to achieve this objective, there must be rules for conveying both the intended use of information and the information content within a network. IBM's Document Interchange Architecture (DIA) and Document Content Architecture (DCA), ▶

Cordell is senior programmer, Information Interchange Architecture, IBM, Austin, Texas.

working together with IBM's Systems Network Architecture (SNA), function to provide the rules for how information flows and is processed in office systems networks.

Simply, the roles these architectures perform are:

- SNA defines the rules for transmitting documents in a network.
- DIA defines the rules for processing documents in a network.
- DCA defines the rules for interpreting documents in a network.

IBM has organized each of these architectures into a set of separate layers that can be thought of as building blocks. The layers isolate the particular function defined by an architecture; provide a clean, efficient, open interface to the next layer; and allow for changes and additions to one without affecting the others (see Figure 1).

IBM has organized each of these architectures into a set of separate layers that can be thought of as building blocks. The layers isolate the particular function defined by an architecture; provide a clean, efficient, open interface to the next layer; and allow for changes and additions to one without affecting the others. These architectures can be viewed as members of the same family.

These architectures can be viewed as members of the same family. Together, they provide the rules for an office systems network solution.

DIA is a process-to-process communications architecture that defines how information and requests for processing functions are communicated in a network. Essentially, DIA specifies the rules and data structure that establish the discipline for unambiguous interchange of information and processing requests between office systems.

DIA can be viewed as consisting of a set of logical components, a set of processing services and a set of protocols.

These areas form the foundation for requesting functions between the office systems. A network of office systems based on DIA is a set of logical, interrelated components that lie within the framework of the physical components of a network. The logical components are defined by DIA and are implemented as process nodes executed within the physical components of the communications network. These are the nodes defined by DIA:

- The source node provides DIA services by initiating and controlling the interchange of information between end users.
- The recipient node provides DIA services by controlling and receiving information sent by source nodes for one or more end users.
- The office systems node is the DIA server that receives, stores, routes and delivers information from source nodes to recipient nodes. An office systems node also interacts with an appropriately configured network to distribute information to other office systems nodes.

Source nodes, recipient nodes and office systems nodes interchange information using the common transport services of the SNA network.

DIA consists of a set of defined services performed by peer communications processes in the network nodes. Each DIA service carries out specific functions requested by the users. Users, in this sense, can be applications programs, devices or people and, as such, represent the source or receiver of information flowing through the network.

The services defined by DIA are analogous to the functions performed in today's modern office. These services can be categorized into the following general areas: document library services, document distribution services and applications processing services.

Document library services provide the capability of an electronic filing cabinet, filing documents electronically, searching for them and retrieving them based on descriptors stored with the document. For example, a user can ask the office system to search for all documents about a particular subject and by a certain author that the library received between any two dates. On completing the search, the office system provides the user a list of the documents that have met the user's search criteria (See Figure 2 on Page 23).

Document distribution provides the capability of a sophisticated messenger service that allows one to enter a single request to distribute documents to multiple recipients, schedule distribution by document priority, confirm delivery and report errors.

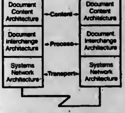


Figure 1. Architecture Layers

Documents and messages are distributed between the source and the recipient nodes through the office systems nodes for later delivery to each of the recipients (deferred delivery) or by sending them directly from the source node to the recipient node (direct delivery).

When documents or messages are delivered through an office systems node, document distribution services in the source node do not establish a direct DIA session with document distribution services in the recipient node (see Figure 3 on Page 23). Instead, a DIA session is established between the source node and the originating office systems node. The originating office systems node then queues the distribution request for later delivery to the specified recipients. If the recipient node is located on a different office systems node, DIA defines an interface to SNA distribution services (Snads) to perform this function. This deferred delivery alleviates the problem of having all the network physical components available to the sender of a distribution request.

When the recipient node establishes a DIA session with its office systems node, it can obtain a summary list of documents and messages. It can also receive any or all the documents or messages, or it can cancel delivery of any or all the information that has been queued for the recipient at the

destination office systems node.

Applications processing services performs the housekeeping role of DIA. It provides the ability to request the formatting and processing of documents, for example, changing the descriptors used in searching the document library.

Information exchanged between DIA processes consists of commands and user information. To achieve this information exchange, DIA defines a request/reply command protocol. To illustrate this request/reply command protocol, a simple DIA request would be "Distribute Document X to Recipients A, B and C." The reply to this request from the server is an "Acknowledge," indicating that the command has been accepted and the document is queued for delivery to the named recipients.

This illustrates that the server responds on demand to the requester. The on-demand request/reply protocol is one of the command classes defined by DIA to perform a unit of work desired by the requester. This command class is called Synchronous Reply Required, that is, the command execution and the command reply are processed synchronously between the requester and the server. Other command classes in DIA are No Reply Required and the Asynchronous Reply Required. The No Reply Required command class is used by the requester when the function does not require a reply from the server. The Asynchronous Reply Required command class is used by the requester when the function requested does not need to be performed synchronously, but can be deferred for later processing.

DIA supports a logical view of an office systems network. This allows users to perform office systems functions without having to know about the physical organization of a network. As IBM increases the services performed by DIA, many manual office systems functions can be done electronically.

DCA describes the form and meaning of information in an interchange document. Currently, DCA specifies two forms of a document. One form deals with text that can be revised by recipients of the document, and the other form deals with text that has been formatted for presentation on a printer or display and is not intended for revision. These DCAs are revisable form text DCA and final form text DCA.

The revisable form text DCA provides for the interchange of revisable text documents in an office systems network. It specifies the required structure and correct interpretation of the controls and text within revisable interchange documents. Revisable means that the original editing constructs are preserved. For example, margin text declarations are individual structures separate from the body text structures of a revisable document. When generally applied, this concept allows for editing entities while retaining the formatting characteristics of the document.

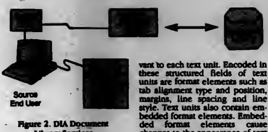


Figure 2. DIA Document Library Services

Revisable form text consists of format elements that maintain the intent of the originator so it can be revised on another system. Some examples of the format elements are top margin text, bottom margin text, type style, line spacing and line style. The purpose of these format elements is to be independent of end use. That is, revisable form text does not specify the user interface for a product, but does specify the correct semantics to be applied to interpret the format elements.

These format elements form the basis for the document creation and revision process. Revisable form text also maintains explicit references to revisable elements and the capability of page image formatting or the reduction of revisable form text to final form text.

The revisable form text data stream consists of three basic units or structures: format units, text units and end units.

The format units contain the format elements for the entire document. Elements such as page size, margin text definitions, footnote rules and placement and spelling dictionary specification are a few of the format elements contained in the format units.

The text units represent the page of a document. Besides encapsulating the text characters for a page, text units contain two types of format elements — structured fields and embedded controls. The structured fields appear at the beginning of text units and contain format information relevant to each text unit. Encoded in these structured fields of text units are format elements such as tab alignment type and position, margins, line spacing and line style. Text units also contain embedded format elements. Embedded format elements cause changes to the appearance of text within a text unit or page. Examples of embedded format elements are type style changes, line formats, footnote references and text field alignments.

The final component of a revisable text document is the end unit. It is used to mark the end of the document.

The structured nature of a revisable form text document allows for the modification of the text information and the individual format elements themselves. In addition, this structure facilitates processes to be performed on a document, such as pagination.

Final form text DCA provides for the interchange of formatted text documents in an office systems network. Like revisable form text, it specifies the controls and the interpretation of these controls and text for final form interchange documents. However, the original editing intent has been processed to a presentation format. For example, margin text declarations have been resolved so that they appear simply as text on each page. Therefore, final form text provides a simple document structure that can be processed sequentially for presentation on a printer or display.

While it is possible to revise a final form text document, the structure of it has not been optimized for that process. The large set of format elements contained in a revisable form text document have been processed down to a set of primitives that have a broad base of support to guarantee information interchange across all products in the network.

The final form text data stream has been developed for serial processing and, therefore, is represented as a sequential byte stream. Text characters and format elements are contained in this byte stream. The format elements consist of two forms — one-byte controls and extended controls, or multibyte sequences. Examples of one-byte controls are back spaces, indent tabs, superscripts, subscripts, line ends and page ends. Extended controls contain parameter information relevant to a particular control, such as vertical and horizontal margin positions, type style definition, page size dimensions, line density and so on. These elements control the placement and appearance of the text information on a page of a final form text document.

The objectives of final form text are to ensure that primitive format information is independent of specific device characteristics, to provide for quality document presentation — for example, justification — and to allow the sender of a document to control the print integrity of the document at the destination.

The requirements for revisable and final form text are sufficiently dissimilar to require separate architectures. The relationship of revisable form to final form text is a process called "print," which, when performed on revisable text, produces final form text. However, where specific controls are applicable to both, they are the same.

Office systems support revisable and final form text DCAs to ensure document interchange among the systems in the network. A sending system is required to map its stored internal document form into the interchange document form requested by the sender. Similarly, on receipt of a revisable or final form document, the receiving system maps the interchange document form into that particular system's internal document form. Functionally, these mappings preserve the intent and information content of a document while allowing each system the flexibility of internal document storage.

The real value of DCA will increase as the sophistication of the material transmitted increases. One future possibility is the mixing of information types within a single document and even on a single page. Data, text, graphics, image and voice annotation can be defined and structured so that these information types can be integrated in a document and distributed throughout the network.

A common architecture solution has many advantages, both for today and for the future. It protects investments in products by permitting functional extensions without making current ones obsolete. It supports flexibility in configuring systems and networks so change can be readily accommodated, and it facilitates the interconnection between many types of products. But the real advantage of a common architecture solution is the ability to get the right information to the right person at the right time. ■

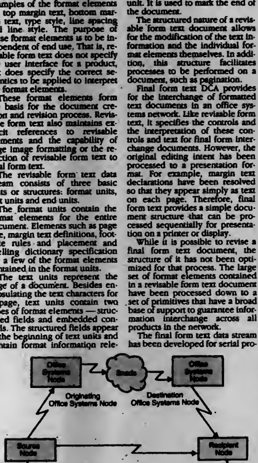


Figure 3. DIA Document Distribution Services

TAKING THE PULSE OF FIBER OPTICS

[illegible]

courses in engineering.

Although he is hesitant to publicize his personality over his work, Ippen took some time to discuss his work with On Communications *Editor Bruce Hoard.*

How will your work on laser light find its way into the world of computers and communications?

It is clear that optical fibers and optical components will play a large role in telecommunications. It is also becoming increasingly clear that these systems are moving rapidly to higher and higher speeds as people want greater and greater capacity. This is what optics and optical communications really provide. In order to provide that capacity, one has to send very short pulses down fibers and learn how to switch short pulses.

Bringing short pulse technology down into practical device regimes is important for optical communications. We already know how to do that, to a certain extent. Our laboratory that produces the shortest pulse in the world — 16 femtoseconds — is really a scientific laboratory. It requires large lasers. The pulses produced are probably shorter than we will ever need to transmit down optical fibers.

However, what we have learned is already feeding back to the optical communications business. We know how to produce pulses less than a trillionth of a second with semiconductor diode lasers, and these are the sources that are used for optical communications systems. Detectors are also being pushed down into the trillionth of a second regime.

We are encouraged that it is now known that very short pulses can be transmitted through optical fiber systems — especially in the long wavelength regime, which is the coming generation of optical fibers. The optical communications medium is there to handle very short pulses and use them. The real trick and the focus of a lot of work is to figure out how you do switching. How do you interface these very high-speed things with conventional electronics and computers running at slower speeds? Through telecommunications, high-speed optics will become important.

How do you condense light into such short pulses?

With lasers, we have the potential for generating very short pulses, because in order to generate such a pulse, you need to put together a lot of frequencies. It is a simple fact of mathematics and physics that the duration of the pulse is inversely proportional to the bandwidth. So you have an enormous frequency bandwidth to create a very short pulse.

We have lasers now that emit over a wide bandwidth as opposed to single frequencies. We use dye lasers, in which the lasing medium is molecules of dye, the substance that colors clothes. Many of the ones that fluoresce turn out to be active laser dyes. When these molecules are excited, they emit light and can be turned into a laser. Because they are complicated molecules, they can do it over a very broad frequency range. This is the medium of the laser.

The technique by which the laser produces very short pulses is called mode locking. Every laser emits in discrete frequencies and in order to produce a short pulse, you have to lock all these frequencies together in a specific relationship. So the laser itself is mode-locked to produce very short pulses. It has to be done by natural physical processes because even the processes involved in mode locking are too fast for conventional electronic modulators or devices.

The process is made to occur by putting the right combinations of materials inside the laser. It is done with two different dyes, one that provides the lasing and the other that absorbs light and helps lock all these pulses together. So then we have a dye laser that produces pulses

IBM to ASCII

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+ Programmability

Host session and asynchronous device parameters are programmable via the setup mode on the system console. Programmable host session parameters include:

- log on information
- device address
- buffer size
- data rate

Programmable asynchronous device parameters include:

- device type
- character framing
- input mode
- data flow control
- output mode
- data rate

Setup data can be permanently held in EEPROM even when the Series II *Plus* is powered off.

+ Speed

Featuring a Z80A processor, the Series II *Plus* is capable of data rates up to 19.2 Kbps or, with optional Z80B processor and DMA, up to 56 Kbps as well as concurrent operation of up to 8 input/output devices at equivalent rates!

+ Code Compliance

The Series II *Plus* converters meet the FCC emissions requirements and are designed to satisfy those requirements when included in subsystems. The Series II *Plus* is also UL and CSA listed.

+ Fluency

The Series II *Plus* provides fluent communications in IBM SNA and Bisync protocols including 3770, 3270, HASP and 2780/3780. All Series II *Plus* converters support a multitude of input and output devices and are available with up to 8 ports (3 in 2780/3780 converters). You can count on the Series II *Plus* for fluent IBM to ASCII communications.

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that are about 55 to 60 femtoseconds in duration. That is pretty short. A femtosecond is 10^{-15} seconds. This is a million times faster than the fastest computer, less than a trillionth of a second, less than a tenth of a trillionth. A trillionth is a thousand femtoseconds. This happens at a high repetition rate, and we use the pulses for various experiments.

About six months ago, we generated the shortest light pulse that had ever been generated, which required compressing these 60 femtosecond pulses down to 16. Previously, the shortest pulses had been 30 femtoseconds, which had been done by some colleagues at Bell Laboratories.

Ippen measures pulses of light in mere femtoseconds.

Splitting these kinds of signals is a problem, isn't it? Have you looked at the problem of tapping into optical fiber?

What we do is really on a research level. We are not so concerned with practical fiber interconnections, but if you have a fiber in which data is coming through at an extremely high rate with pulses following each other, they are coming too fast for a lot of switching systems and computers to use. You have to figure out a way to divide them up, demultiplex them, because they have all been presumably multiplexed at the front end. We are looking at devices here that multiplex and demultiplex, sample, code and decode these very high data rates.

How hard is it to encode such short pulses of light with some kind of information?

It is not hard to turn a light pulse on and off. They can be turned on and off when they are coming at a fairly slow rate. For us, that would be gigahertz rates, many gigahertz even. That is faster than current technology, but we know how to do that with optoelectronics and the fastest computers in the world, those that handle information in nanoseconds. But one possibility is that these pulses, running at rates that one can handle, can then all be fed and multiplexed onto communications systems and demultiplexed at the other end. There are a few applications where one may want to do it at speeds that exceed what one can do with electronics.

What are these high-speed applications you are talking about?

There are some applications where data is coming at a very high speed and you want to make some decision or some encoding or decoding at that very high rate, even before you can multiplex it. If you go to high rates, you may need to do extremely high switching just to do the multiplexing and demultiplexing. We are interested in devices where we can use one optical pulse to switch another optical pulse.

How long will it be before that kind of technology becomes commercially available?

That will be in a 20-year time period, although we have just this past year demonstrated in the laboratory the first device that does it in a way that looks close. The real problem is that people know how to do this with high-power lasers. But the key is: Can you do this with the powers and energies that one has in practical sources, little laser diodes, the kinds of things that are going to be integrated packages? That is a lot harder, but again there is increasing interest in the area.

How is the optical fiber you work with different from that used to conduct digital voice and data transmission in a network like AT&T's?

In terms of the fibers and the lengths, we are not talking about anything radically new. For very high speed, one clearly needs monomode fibers, and one needs monomode fibers in the long wavelength regime.

What is the difference between monomode and multimode?

A multimode fiber is a larger diameter fiber that is easier to couple light into, which is why people started out with it. But besides being easier to couple light into, it is easier for the light to travel a variety of different paths through this fiber. It is easy to understand how light going by different pathways, with some rays making more bounces than others, will wind up at the end of the fiber at different times. There is a speed limit. If you try to do anything too fast in a multimode fiber, it gets mushed up at the output. In a single-mode fiber, there is only one way in which the light can propagate down the fiber, and that is really the best you can do in terms of mode design. The next step is to choose the particular material and the wavelength and the subtle designs of a single-mode fiber to maximize even the bandwidth of the single-mode fiber.

So the fiber you are using is similar to what we would find in commercial use today?

It is similar to the fiber that is coming into commercial areas.

So it is not the fiber, it is what you do with it that counts?

That is right. The transatlantic fiber cable going in over the next few years will all be single-mode, long wavelength fibers.

Did you believe 10 years ago that fiber optics would become such a popular transmission medium?

Yes. It had apparent advantages. One was that it clearly offered bandwidth and capacity capabilities beyond what one could ever get with coaxial cable. It also offered the advantage of being small and relatively simple.

I guess what was not apparent 10 years ago was just how fast all this would come about. The growth that we have seen today in the communications industry was not so apparent 10 years ago.

Then, several things happened. What first brought fibers into the business and made them commercially interesting was not so much the exotic high-capacity use that we knew they would eventually provide, but the fact that they were lightweight and smaller than cable. They could fit more of them into the ducts under some of the big cities.

In addition, the Japanese made a strong commitment to optical communications and the optics industry. With that strong commitment, there was also a danger we would lose the technology, unless U.S. industries got into it quickly. So that impending competition plus some of the more prosaic uses brought fibers in. Once fibers came in, the people saw more and more of their advantages. At the same time, the need for communications was growing dramatically.

How long has this kind of research been going on?

Since the invention of the laser, people were working on systems to transmit information through laser beams. Even in the '60s, optical fibers were under consideration, but it was not clear that they would be practical. In the early '70s, when people demonstrated that they could make glass good enough to transmit light at such long distances, all of a sudden, everybody became excited. ■

Special Section

Digitizing America

NETWORKING MICROS ON THE DIGITAL PBX

By Ian Angus

Integrated voice and data saves money, reduces complexity, eliminates cables and improves management: The claims seem endless. If we are to believe the advertisements, organizations that are not using voice-data private branch exchanges (PBX) are a minority of hopeless Neanderthals, doomed to fall by the ▶

Angus is president of Angus Telemanagement Group, a consulting firm based in Toronto and Boston, and editor of the newsletter, Voice-Data Report.

wayside as their competitors seize the strategic advantages of integration, establishing the voice-data PBX as the corporate office controller.

IN FACT, ALTHOUGH voice-data integration is popular in advertisements and magazine articles, little integration has actually taken place. The three market leaders (Intecom, Inc., Rolm Corp. and Northern Telecom, Inc.) shipped fewer than 35,000 data interfaces last year — about .05% of their installed base of digital PBX lines.

There are four major reasons for the somewhat slow acceptance of the voice-data PBX.

Delays in availability. Although several manufacturers announced voice-data PBX systems or data capability on previously voice-only systems in 1979 and 1980, no one started shipping until 1981, and substantial shipments did not begin until late 1982 in most cases. Some manufacturers — for example, AT&T and Mitel Corp. — did not have deliverable systems until 1984, while others — for example, Datapoint Corp. and the Wescom Division of Rockwell International Corp. — did not deliver on their promises at all. These delays reflect a combination of preannouncements designed to preempt market share and serious underestimation of the time and money needed to bring a voice-data digital PBX to market.

From this view, 1983's low sales reflect a slow start, not a failure after several years of sales. Angus Telemanagement Group's research indicates that 1984 shipments will be double those in 1983, and several firms report backlogs that could lead to shipments doubling again in 1985.

Cost. Despite promises of cost savings through reduction in duplication of facilities, simplified moves and changes and improved management, it is still difficult to identify significant savings with an integrated voice-data PBX. Adding data switching to an existing digital PBX costs between $500 and $1,500 for each data connection, depending on the manufacturer. This is comparable with the cost of most cable-based local networks, but it is above the cost of a data PBX using limited-distance modems or data-over-voice technology on standard telephone wire. The cost of voice-data integration must decline dramatically for it to be widely accepted.

There is some evidence that this is taking place. PBX per-line prices have fallen substantially since 1980, and the cost of data interfaces has fallen even more. Recently, the Computer-to-PBX Interface developed by Northern Telecom and Digital Equipment Corp. reduced the cost of PBX mainframe connections by as much as 50%, and AT&T Information Systems' Digital Multiplexed Interface promises to do the same for its systems. In 1985, telephone sets with integral data interfaces as standard features should be introduced, which will allow manufacturers to produce sufficient volumes to bring prices down again.

Technology limitations. So far, voice-data PBXs have been addressing a limited segment of the data communications market: connections for Ascii terminals, transmitting asynchronously at speeds up to 19.2K bit/sec. Higher speed connections and, above all, connections to IBM equipment were simply not available, except in the form of protocol converters or so-called gateways that allow Ascii terminals to communicate with IBM equipment. Currently, the leading PBX manufacturers all support synchronous communications up to 56K or 64K bit/sec, but shipments have barely begun, and it is hard to identify a clear market for it.

Several manufacturers have announced coaxial elimination features for IBM 3270 environments and high-speed capability — Ethernet emulation, super-multiplexing and so on. But as of summer 1984, none of these products were actually being shipped. The 3270 coaxial eliminators hold considerable promise, now that IBM's Cabling System has given credibility to the idea of using twisted pair for such connections.

Unintegrated management. While integrated planning gets lip service in most major corporations, there is still an iron curtain between voice and data communications management in U.S. business. Even where a unified department has been created, the unification often amounts to no more than shuffling boxes on an organization chart. Implementation of a voice-data PBX requires a breakdown of organizational barriers, undermining someone's authority. Data processing managers have been reluctant even to consider having any data communications handled through a box that is not in the computer room under direct DP control.

This division is paralleled in the vendor community by a shortage of sales representatives who understand both voice and data. Most PBX salesman get as far as saying, "And you can switch data, too," before exhausting their knowledge of the subject. This

does little to win the confidence of harried DP managers.

Several vendors have responded to these parallel problems by improving training, hiring sales representatives with computer communications backgrounds and targeting almost all of their sales efforts at the DP community. It is common to find salesmen bypassing the voice manager entirely to win DP support. This is a dangerous approach, because it can alienate the voice manager. Nevertheless, it has produced some large sales.

In the long run, the division between voice and data management is the biggest marketing problem the voice-data PBX vendors face. This does not mean that the voice-data PBX vendors should concentrate all their efforts on reorganizing corporate America before they go for substantial market penetration. There are two countervailing trends that promise a bright future for the voice-data PBX.

First, the increasing availability and declining cost of digital network services — particularly the so-called T-1 or 1.544M bit/sec channels — make the PBX an extremely attractive voice-data network controller for large, multilocation organizations. The major digital PBXs can interface directly to such channels and make possible high-speed, virtually error-free data communications coast-to-coast. By dynamically allocating the digital facility to voice or data as required, the total cost of a network can be reduced dramatically.

Second, and even more important for the future of the digital PBX in the short run, is a probable radical increase in demand for the type of data communications the PBX handles best: asynchronous switched connections at 9,600 bit/sec or less. The source of these transmissions will be the personal computer.

This is not the place to analyze the proliferation of personal computers in U.S. businesses. The critical points are those that make the PBX the ideal vehicle for most personal computer communications. These points are:

- *Personal computer communications are PBX-compatible.* Personal computers typically communicate at speeds under 9,600 bit/sec, asynchronous, in Ascii, through an RS-232-C port. Every voice-data PBX on the market supports that type of connection easily and increasingly cost-effectively. And there is the genuine option of plugging the personal computer into the phone.
- *Personal computers require access to a variety of communications services, but the volume of use is light.* Most personal computers are used most of the time for local processing — usually word processing and spreadsheets. Their communications needs are extremely varied — a single user may wish to connect to MCI Communications Corp.'s MCI Mail, followed by a remote data base, followed by a shared printer — but each connection is relatively brief. A heavily used machine might have a total connect time of 45 minutes a day. This is similar to most telephone communications — a typical business telephone is in use less than an hour a day and for about 10 minutes an hour during peak times. Voice PBX technology is designed precisely to optimize the use of expensive resources such as switching and trunking, while also providing switched connections among a wide variety of sources and destinations.

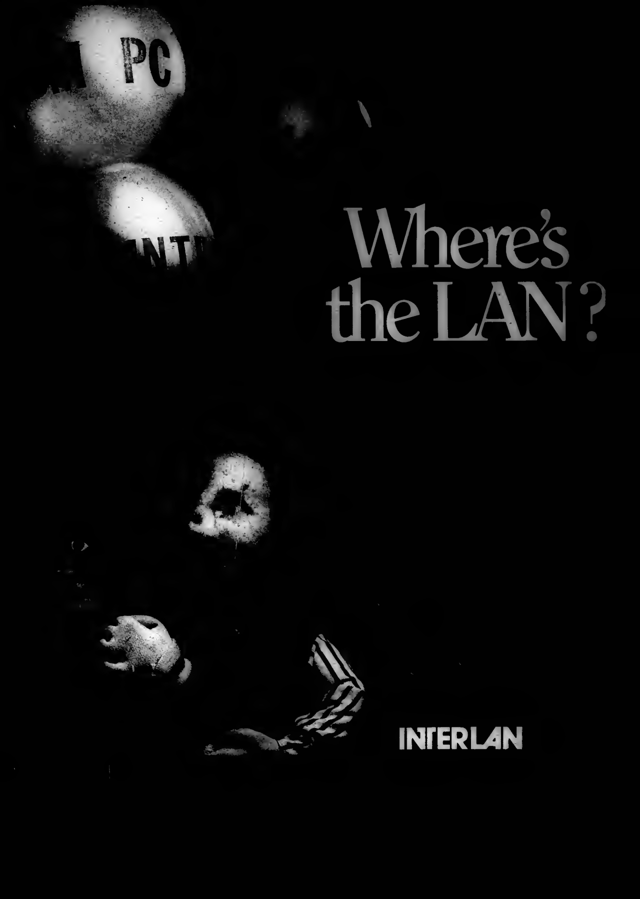
A PBX is fundamentally a switching system that provides contention access to shared resources: This is exactly what personal computers need. By using the modem pool feature of most voice-data PBXs, a group of personal computers can share access to a single 9,600 bit/sec modem, instead of using individual 1,200 bit/sec units connected to dedicated lines. The cost of hardware is reduced, and the cost of transmission is reduced by transmitting faster. In addition, the least-cost routing and call detail recording facilities of the PBX, already in use for voice, provide effective means for controlling and allocating the cost of personal computer communications, at virtually no incremental cost.

In addition, for in-house communications, including terminal-to-terminal and terminal-to-printer links, the PBX can function as an RS-232 extender with switching capability. The ability to share a departmental letter-quality printer can make communications capability extremely attractive to personal computer users.

- *Currently, the personal computer is becoming ubiquitous; the PBX already is.*

It is impossible to predict where a personal computer will appear next, who will use it or what it will be used for. Companies with rigid personal computer purchasing rules quickly find that managers bring their home computers into the office or conceal personal computer purchases in the furniture budget.

Even if the PBX is not the ideal communications system, it has a gigantic strategic advantage: It is already connected to every desk. Those digital PBXs that treat data identically to voice, eliminating



PC
Where's the LAN?
INTERLAN

the need for special software and programming, are, in effect, in-place local networks, waiting to be used. The PBX not only reaches everywhere there is a micro today, it reaches every place where there might be one tomorrow. No other network can make that claim.

■ *The personal computer is seldom under DP control.* The jurisdictional disputes that have helped to keep most terminal-to-mainframe traffic outside the PBX do not apply to the personal computer. In most cases, the micro is locally managed. Often, it falls under the office manager's jurisdiction. Unlike the DP manager, the office manager is used to cooperating with the telecommunications manager. In many organizations, they are the same person. This creates an opening for the PBX vendors to exploit. It also allows the telecommunications manager to expand his empire without treading on DP toes.

And when micro-to-mainframe communications becomes as desirable and practical as the advertisements claim it is now, the DP department can treat the PBX-personal computer network just the same as any other remote system coming in through the telephone wires.

Every PBX manufacturer has a standard office controller diagram that shows his PBX at the center of a vast array of devices, from telephones to terminals to mainframes. While that may be good marketing, it does not reflect reality. Certain types of data transmission can be handled best through cable-based networks or direct connections. This is particularly true of high-speed and high-volume applications and transmissions requiring long connect times. Other transmissions — notably the telephone-like needs of the personal computer user and the primarily for show executive workstation — are ideally suited to the PBX. Between the two is a no-man's-land that will be fought over for many years to come. ■

Special Section: Digitizing America

BEYOND THE DIGITAL HORIZON

By Bob Wallace

With all the talk of AT&T Communications and the other common carriers' colossal planned construction budgets for the upcoming year, one expects these carriers to be constructing forests of microwave towers and spinning webs of fiber-optic cable across the nation, in efforts to add digital capacity to their long-haul networks.

AT&T Communications has two reasons to include digital ▶

Wallace is a staff writer for On Communications.

technology in its long-haul communications network. "We want to serve the data communications market while taking the voice market — which does not demand data or digital communications — and making it less costly to operate," George Petty, director of systems planning for AT&T Communications, explained.

By digitizing its long-haul communications network, MCI Communications Corp. is striving to expand the system's capacity rapidly, according to MCI spokeswoman Helen Peterson. The bulk of this capacity will be used to attract potential voice service subscribers in markets opened by equal access, which is expected to put them on an equal footing with AT&T as far as the quality of connection to local switches is concerned. The remainder will be used as a vehicle for extending MCI's data services to an increasing number of markets.

Digitizing a long-haul communications network requires a huge capital expenditure. It is this heavy investment that may force smaller common carriers to consolidate while pushing the resellers toward the precipice.

The costs involved with digitizing a long-haul network are quite staggering. "Roughly 20% to 25% of the $2 billion AT&T Communications has slated for total network construction for the next year will be wrapped up in digital transmission systems," Petty said.

According to Peterson, MCI plans to spend $1 billion for total network construction in 1985.

The carriers' huge investments in their networks will predictably greatly affect the cost for their services. George Pfister, president of Perspective Telecommunications Group, referring to AT&T Communications, said that a doubling of rates for data lines for the next three to five years might result, as the carriers attempt to recoup partially their investments. There appears, however, to be a light at the end of the tunnel. This same industry watcher expects prices for data circuits to drop in the next five to 10 years, as the result of the deployment of more digital technology in the network.

The analog long-haul transmission world has not disappeared, although it is beginning slowly to diminish in size. "The development of fiber-optic technology has really hastened the end of analog long-haul transmission, which will become as outdated as vacuum tubes were when transistors came along," John Kessler, president of Kessler Marketing Intelligence of Newport, R.I., explained.

The ancillary motives for the carriers' decisions to begin digitizing their long-haul networks are numerous, with the cost efficiency of digital voice and data transmission topping the list.

"It is much more economical to convert a long-haul system from analog to digital," Kessler added. "As the accuracy of the transmissions in a digital system increases with distance, the need for additional amplifiers or repeaters decreases. Fewer repeaters means that the system's electronics, maintenance and labor costs will drop."

Chris Whichard, of Advanced Resources Development, Inc., explained, "Data travels much better when it is digitized and the quality level of the message is improved. These advantages also hold true for digitized voice."

Common sense also dictated the need for conversion for the data market. "The world is computer nuts," he said. "We have digital micros and computers everywhere. If you are going to use these units for communications, naturally, you would continue with the digital technology where transmission facilities are concerned."

AT&T Communications' Petty explained, "What has happened in the data market is that the new data processing architectures

have moved toward computers requiring very high-capacity, long-distance interconnections. It used to be that a 9,600 bit/sec line was a high-speed data link. Now, our customers want high-speed data lines in huge quantities."

Digital transmission offers voice users relatively noise-free circuits. "The nature of the way an analog transmission works is the signal repeater amplifies the signal as well as noise resident in the system and resends it," Daniel Riker, MCI's director of transmission systems planning, said. "Noise in the system accumulates, and over a long distance on an analog system, you are likely to have fairly noisy circuits." In a digital transmission system, a digital signal is regenerated and resent, minus the noise.

This move toward digitizing long-haul communications networks has not been sudden. The conversion is an evolutionary process, as opposed to a reaction to some pent-up demand for digital long-haul transmission. Digital transmission facilities and switching techniques have existed for more than 20 years. They have tended to be of better quality than their analog counterparts. Only recently have digital switches become less expensive.

Digital technology remained on the shelf because, before distributed data processing came into vogue, data communications customers were pacified with existing analog networks for voice and point-to-point data communications.

Both AT&T Communications and MCI are currently facing huge demands for capacity on their systems. Petty readily admits that AT&T Communications is "behind the eight ball" in serving its data communications customers while striving to reduce the operating costs of its voice services.

Riker said MCI is attempting to increase its network's capacity to accommodate new voice customers as equal access is phased in. Consider the capacity needed for MCI's Digital Terrestrial Service and other planned digital services, and you can understand why Tony Martin, MCI's senior manager for planning and analysis, referred to MCI's move to digital as a "rapid migration." AT&T Communications and MCI view digitizing their long-haul networks as the means by which to increase their networks' capacity exponentially.

Ian Sugarbroad, director of product line management for Northern Telecom, Inc.'s Transmission Group, said that digitizing one's network is essentially a two-step procedure. The carrier must install digital switches at its offices. Then, after this equipment is in place, the carrier must either digitize existing transmission media or acquire and install new digital transmission media.

"The name of the game is to eliminate analog circuits at all costs, because that is where all the noise and performance degradation occur. The quantizing distortion introduced with switching is peanuts compared with the noise you pick up on an analog circuit over several hundred miles," he said.

Digital technology remained on the shelf because, before distributed data processing came into vogue, data communications customers were pacified with existing analog networks for voice and point-to-point data communications.

Quantizing distortion is encountered when a voice or data signal undergoes repeated analog-to-digital or digital-to-analog conversions, or both. Pfister said that this phenomenon is generally not encountered until after a signal has traveled through six or seven such conversions.

MCI has been rapidly installing digital toll switches and, according to Riker, has a digital switching capacity in excess of 75%. Northern Telecom and Digital Switch Corp. are the predominant suppliers of digital switches to the carrier.

Lou Verchot, senior analyst for the Eastern Management Group, predicted that AT&T Communications' digital switching capability will reach 85% by 1985. The carrier is reportedly relying predominantly on Western Electric 4ESS and Northern Telecom DMS 200 switches for long-haul digital switching. Verchot said he expects to see an increasing number of Western Electric's latest toll switch, the 5ESS, incorporated into this long-haul network.

Both of the companies have

embarked on quests toward fully digitizing their long-haul transmission facilities and have embraced fiber optics as the technology that will provide their networks with limitless digital capacity. However, there are other technologies that may figure in the digital long-haul future (see story below).

ALTHOUGH IT APpears that the other common carriers and AT&T Communications are constantly laying fiber and constructing microwave towers helter-skelter across the nation, there is a method to what many perceive as their madness. The carriers' commonsense approach is to match the most appropriate and cost-efficient transmission medium with the voice and data needs of the region to be served.

This practice explains why both AT&T Communications and MCI connected the high-density voice and data corridor from New York to Washington, D.C., with fiber-optic cable. This practice also explains why full digitization of all carriers' long-haul networks, the integrated services digital network, is not expected to occur "for at least 15 years," according to Kenneth Bosomworth, president of International Resource Development, Inc. of Norwalk, Conn.

AT&T Communications was first to connect New York and Washington, D.C., with fiber-optic cable, completing this digital link early in 1983. MCI followed, installing a fiber-optic link of its own. AT&T Communications opted for multimode fiber-optic cable, which was state-of-the-art technology at that time. MCI opted to wait for the development of single-mode fiber before constructing its New York to Washington, D.C., link.

Petty and Riker agree that single-mode fiber is currently capable of higher overall throughput than multimode. Riker said he sees multimode fiber-optic cable as being less cost-efficient than the single-mode variety because it requires signal repeaters to be spaced at far shorter intervals in the cable.

Sugarbroad claimed that MCI's link, which incorporates 405M bit/sec electronics, is superior to its competitors' fiber tie, which runs at 90M bit/sec. Petty defended the laying of the multimode cable between New York and Washington, D.C., saying that AT&T Communications knew "without a shadow of a doubt that by the time service was put on the cable, multimode fiber-optic cable would be obsolete. We wanted to test and understand it while single-mode was on the drawing board."

Petty said he would prefer to see a predominantly fiber-optic cable-based AT&T Communications' network to satisfy the hunger of its ravenous data communications users.

"The current data market has driven demand for large digital pipes right through the roof. We have accelerated our digital network plan by 18 months. Our goal is to meet this demand with true digital transmission, which means that we will be rolling in the fiber as soon as the economics improve." He added that he expects to have 120 major metropolitan areas served by fiber-optic cable by 1988.

Although Petty admitted that installing fiber-optic cable throughout the nation would not be cost-efficient now, AT&T Communications plans to have Boston, New York, Philadelphia, Washington, D.C., and Richmond, Va., metropolitan areas connected to the original link by the end of this year.

In addition, the carrier has announced five fiber-optic cable routes scheduled to begin operation in 1986: Philadelphia to Pittsburgh, Pa.; Pittsburgh to Cleveland; Dallas to Houston; San Antonio, Texas, to Seguin, Texas; and Atlanta to Charlotte, N.C., and Greensboro, N.C. All new stretches will reportedly use single-mode fiber-optic cable and will have different capacities, Petty said.

MCI's single-mode fiber-optic cable route, which incorporates 405M bit/sec electronics and connects New York and Washington, D.C., provides this carrier with more than 4½ times the capacity of AT&T Communications' 90M bit/sec link between these two areas, according to Sugarbroad. This fiber pipe creates 6,000 voice channels per fiber pair and is currently lightly loaded, Riker said.

Construction under way will provide MCI with a fiber-optic cable link connecting Chicago to the existing Washington, D.C., to New York route. Riker expects this fiber-optic leg to be completed by early next year.

Shorter fiber routes include a single mode stretch between Los Angeles and Dominguez Hills, Calif., a 15½-mile distance, and an intrastate line in Florida that will eventually connect with Atlanta. Future planned fiber-optic trails will connect Chicago to Cleveland, Cleveland to Pittsburgh and Pittsburgh to Washington, D.C.

Riker currently views fiber-optic cable as a capacity easer rather than a primary path, but admitted: "It will become our largest transmission component by 1987." ■

Alternative Technologies in the Long-Haul?

Although fiber optics is most often discussed as the digital long-haul medium of tomorrow, questions remain as to what role microwave, coaxial cable and satellites will play in the future of these carriers' long-haul networks.

Analog microwave transmission currently handles 73% of AT&T Communications' long-haul network traffic, but it can be converted to digital for the future. "We see a role for microwave all the way out," George Petty, director of systems planning for AT&T Communications, said.

"Think of fiber in terms of a 747 and microwave as a 727. If you are going to run an airline efficiently, you are not going to send a 747 into Cheyenne, Wyo.

"With our microwave radio, by simply changing the electronics, we can convert it to digital with two to three times the capacity of the analog," Petty said. "As the technology is developed, we [illegible] is toward making the conversion of existing systems at very low costs." He predicted that most of the network's 4- and 6-GHz analog microwave will be converted to true digital microwave in the next five years.

MCI Communications Corp.'s long-haul network, which is composed primarily of 6-GHz analog microwave radio, has begun a major transformation that Daniel Riker, MCI's director of transmission systems planning, feels will move the facility toward full digitization by the mid-1990s. The carrier has augmented its existing microwave plant with a New York to Chicago digital microwave link.

The company's latest network expansion plan centers on the construction of the mid-America route. This is a microwave route built primarily in 4-GHz digital that begins near Baltimore, where it connects to existing New York to Washington, D.C., fiber-optic and microwave routes.

The route will range as far west as Salt Lake City, tying in with existing transmission facilities along the way. Once completed, the mid-America route will reportedly provide MCI with at least 50,000 additional voice frequency circuits. The portion of the route connecting Kansas City to Denver was the first link to become operational.

Although building routes in digital microwave appears to be the trend, Riker said he sees single sideband radio as a means of extending the life of analog microwave. Single sideband radio technology enables analog microwave radio users to double their voice circuit capacity on a single radio frequency.

He said that 6-GHz analog microwave with single sideband radio provides 5,400 voice channels, while 6-GHz digital microwave technology derives only 2,016 channels. Riker added that these analog stretches will be converted to digital in the next decade, to interface the digital transmission facilities that MCI plans to have installed by that time.

Coaxial cable currently handles 23% of all AT&T Communications' long-haul network traffic. But of all AT&T Communications' long-haul transmission facilities, it is the best bet to become the first entry on the endangered media list. Petty predicted that the composition of the long-haul network in five years will be roughly 50% microwave and 50% fiber-optic cable.

The carrier's 13 coaxial lines, which serve the network's smallest routes, will all reach coaxial heaven by 1986. The routes, which run primarily through Texas, New Mexico, Arizona and out to California, will be replaced by fiber-optic cable, Petty said.

AT&T Communications' 14 coaxial routes, which run from Chicago through Colorado, Wyoming, Utah and out to the West Coast, are currently being converted to digital. The carrier is converting these lines to digital by removing the existing analog signal repeaters and replacing them with digital signal regenerators.

The company's major long-haul, coast-to-coast 15 coaxial routes are currently analog. AT&T Communications is in the midst of deciding whether to convert the coaxial to digital or simply retire the cable and replace it with fiber-optic cable.

Satellites, as a medium for domestic long-haul communications in the AT&T Communications network, currently handle a mere 3% of network traffic. The satellite connections are primarily used for international communications, according to AT&T spokeswoman Gail Purpura.

Pfister explained, "If they run out of all possible media in their network, then they will consider giving you a satellite channel."

AT&T District Manager of Satellite Systems Jack Zaskany defends the role of satellites in the long-haul network, citing that their cost is insensitive to distance. Detractors invariably mention propagation delay, the time it takes for voice or data to travel 22,000 miles each way, to or from the satellite, as detrimental to low-speed interactive data processing applications.

Satellite fights in MCI's long-haul network "will form a very small [illegible] of our overall [illegible]," Riker said. "Satellite [illegible] reach a location [illegible] you [illegible] reached [illegible] your [illegible] system. They [illegible] very long-distance [illegible] of to connect places like [illegible], Montana and the Dakotas, [illegible] have no microwave."

— Bob Wallace

GOING DOWNTOWN WITH DIGITAL

By George Pfister

The future of metropolitan-area digital communications is commonly linked with the term bypass. The subject has created a furor among telephone companies, regulators, legislators and consultants. It is helpful to look at the capabilities of the local telephone companies, since they will service the vast majority of customers and are poorly understood by individuals without a ▶

Pfister is president of Perspective Telecommunications Group, Paramus, N.J.

telephone background.

In most cases, telephone company twisted pair is installed in 2,700- or 3,600-pair cables. These trunk cables are distributed in two ways: bridged and dedicated.

Older cable distribution systems used a technique termed bridged taps, in which the cable was physically tapped to distribute a number of pairs. Bridged taps can cause signal reflections if high-speed data is transmitted, for example, 56K bit/sec.

Ultimately, bridged taps proved to be labor-sensitive, and a technique termed dedicated loop plant became the accepted installation procedure in the '70s. In this approach, the trunk cable is broken down into discrete 100- to 300-pair bundles and is terminated directly to a building in the business environment. The problems inherent in bridged plant are thus eliminated.

Another limitation of the twisted-pair plant is the loading coil. Loading coils are installed on loops longer than two miles and restrict the bandwidth carrying capacity of the loop to the 4-KHz band for long-distance voice transmission.

However, as a result of proximity to the central office, loading coils may not have been used in the first place. They are generally easily located and removed for special service circuits.

Developments in digital transmission in the toll plant between central offices resulted in the introduction of T-1 carrier in the early '60s. Similar digital technology was applied to the local loop plant in the early '70s in the form of Subscriber Loop Carrier, or SLC-96.

While SLC-96 technology introduced digital transmission into the existing local loop plant, most Bell operating companies have been installing fiber-optic systems, referred to as fiber SLC, in their new cable routes. These fibers are currently being installed at the 6M bit/sec rate, similar to SLC-96, but can be upgraded as required to 45M bit/sec or in increments of 45M- to 90M bit/sec and possibly even 135M bit/sec. These rates correspond to 672-, 1,344- or 2,016 64K bit/sec digital paths. The upgrade to these higher speeds will easily be accomplished by simply upgrading transmitters and installing the appropriate multiplexers.

The newest philosophy in local plant is the Serving Area Concept illustrated in Figure 1. In this mode of installation, fibers are terminated at a strategic location and a predetermined number of pairs are distributed to a remote terminal that is simply a mini cross-connect frame. To summarize the telephone companies' position, the existing twisted-pair plant is ubiquitous and capable of supporting higher speeds than 9.6K- to 19.2K bit/sec, which many believe is the maximum it can handle. At distances up to three miles, 56K bit/sec can be supported, and 1.5M bit/sec can be supported at distances of a mile or so. Techniques such as SLC-96 can be applied cost-effectively to most business locations, and newer installations are being undertaken with fiber optics.

Microwave radio is the most popular alternative technology for private metropolitan networks for a number of reasons:

- Cable right-of-way negotiations are not required, which is a particular problem where multiple municipalities are involved.
- The technology that was developed in the late '40s is well-documented at this point.
- Installation costs are comparatively low compared with private cable.
- The armed forces trains a large number of technicians, and as a result, support staff can be relatively easily acquired.

Figure 2 provides a comparison of the four microwave frequencies currently available for private networks. The 12-GHz band will be preempted by direct broadcast satellite in 1988. The Federal Communications Commission (FCC) has allocated spectrum in the 6-GHz band.

The higher frequency — for example, 18- or 23-GHz — systems have significantly better price/performance than the older low frequency — that is, 2- or 12-GHz — systems. This stems from the fact that towers are not required for antenna support for the small high-frequency dishes.

The higher frequency systems are packaged to appeal to the relatively small user, transmitting 48 to 96 voice frequencies, and additional cost benefits are attributable to less stringent FCC filings and detailed route and spectrum surveys. However, price and power go together, at least for microwave, and the user contemplating a link in excess of 10 miles will have to use the more powerful 2-GHz or the new 6-GHz systems.

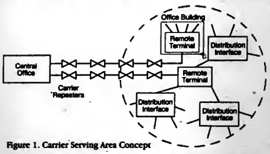


Figure 1. Carrier Serving Area Concept

Fiber optics can be installed by a user if right-of-way can be obtained, and it is competitive with 18-, 6- and 2-GHz microwave at short distances. Of course, 23-GHz radio will always be superior for small — that is, 48 to 96 voice frequencies — or medium-size capacity link, at short range.

Fiber optics will generally be used in high-capacity situations, and even where 18 GHz has an economic advantage out at five miles, the fiber approach might prove preferable, since its ultimate capacity is many times that of the 18-GHz system.

Figure 3 provides a comparison of fiber and microwave 2- and 18-GHz radio and assumes rural installation. Microwave transmission is distance-independent and requires no right-of-way; 18-GHz radio performance is suspect beyond seven miles. While conduit rental looks attractive, this installation figure does not include conduit rental, which in many areas could be as expensive as $20,000 to $25,000 per mile each year.

Digital termination service (DTS) is a broadcast local communications technology that allows for the sharing of bandwidth. DTS is targeted primarily at data applications; however, the newer point-to-point or second-generation systems with a capacity of 24 T-1 links could possibly handle voice distribution.

The first-generation DTS system operates with a relatively expensive master station at $100,000 to $200,000, but is geared to a larger number of inexpensive subscriber antennae costing $10,000 to $15,000. As the number of users increases, DTS becomes economically attractive.

One of the major advantages of DTS is that an installation can be made in hours or days.

Just how well DTS will develop is anyone's guess, but there is plenty of bandwidth available, since in the 10-GHz band there are seven extended and six limited carriers, which add up to approximately 35 MHz per city for the extended carrier. The FCC has recently opened the 18-GHz band for DTS, adding even more capacity.

Cable television has the advantage of being installed, but it has problems. It is:

- Installed in the wrong places, that is, middle class suburbs vs. downtown; installed with the wrong cable, simplex vs. full duplex; an analog media that can waste bandwidth for digital voice transmission; and installed by multiple franchises in a single city.

A raft of other technologies is cited for private metropolitan networks. Most of these are severely limited. They include:

- *FM sideband:* Bandwidth limited to supporting pagers or super-beepers.
- *Light links:* Short distance, susceptible to snow interference.
- *Multiple distribution service:* Cableless pay television that is limited in its own two-way capability.
- *Cellular radio:* For support of mobile phone service, it will be saturated with the pent demand for mobile phones.

It can be concluded that the telephone companies will continue to dominate the intracity communications network markets as a result of their installed twisted-pair plant.

The telephone companies' ability to convince the regulators to allow them to price their services on a cost basis is crucial to their success in this market.

Other technologies, principally DTS and high-frequency private microwave — 18- and 23-Ghz — will grow rapidly in response to unresponsive telephone companies, uncooperative regulators, tariff anomolies and obsolete telephone company plant.

If it is assumed that in the long run the phone companies will be responsive, bypass technologies should be viewed as transitional, and as such, short-term write-offs should be preferred. ■

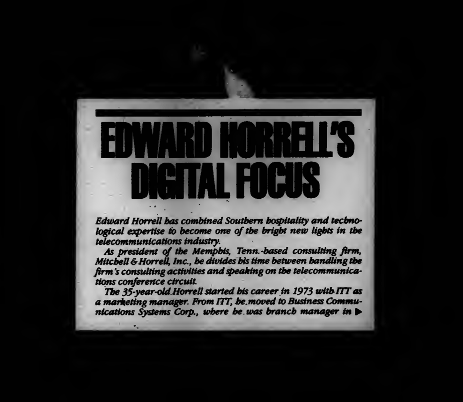
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Range	25 miles	25 miles	7 to 10 miles	3 to 5 miles
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Radio Cost	$ 60,000	$150,000	$70,000	$15,000
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Multiplexer Cost	$ 8,000	$ 28,000	$ 8,000	$ 2,000
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total Fully Equipped	$193,000	$278,000	$88,000	$21,000

Figure 2. Microwave Frequency Comparision

Transmission Method	2 Miles	5 Miles	10 Miles
[illegible]	[illegible]	[illegible]	[illegible]
18-GHz Microwave (192 Voice Frequencies)	$ 88,000	$ 88,000	$ 88,000
[illegible]	[illegible]	[illegible]	[illegible]

Figure 3. Fiber vs. Microwave Costs

Special Section: Digitizing America



EDWARD HORRELL'S DIGITAL FOCUS

Edward Horrell has combined Southern hospitality and technological expertise to become one of the bright new lights in the telecommunications industry.

As president of the Memphis, Tenn.-based consulting firm, Mitchell & Horrell, Inc., he divides his time between handling the firm's consulting activities and speaking on the telecommunications conference circuit.

The 35-year-old Horrell started his career in 1973 with ITT as a marketing manager. From ITT, he moved to Business Communications Systems Corp., where he was branch manager in ▶

Edward Horrell

the firm's combined Chattanooga, Tenn., and Dayton, Ohio, office. He joined Northern Telecom, Inc. in 1976 as manager of its Memphis office.

He put in a two-year stint at First Tennessee Bank as in-house communications manager before moving to Mitchell & Horrell 3½ years ago.

A devoted sportsman, the Memphis State University graduate and father of two tikes to play tennis and coach soccer, baseball and basketball.

On Communications *Editor Bruce Hoard talked to him recently about the future of digital communications.*

How far have we come toward a fully digital U.S. transmission network?

Back in 1976, the network was projected to be digital by about 1985. Obviously, we are still short of that. What we are seeing now is a migration, a quick migration into a combination of T-1-type network and fiber-optic network. I think the move toward the fiber network is coming along a lot more quickly than people had anticipated.

As far as the migration goes in the major cities — cities of more than 300,000 in population — we are going to see the possibility of an entirely digital community in the next few years. When you talk about the small rural markets, we still have a long way to go.

What areas of the network do you predict are going digital first?

You are seeing new types of service from the central office that are combining voice and data over the same medium. This is coming primarily in two forms. One is the conventional T-1 that we have been kicking around for a while. The second is coming in the form of fiber from the operating company, and it is causing the user to change his mechanism of service with regard to the amount of services that he is going to order.

In the past, the user ordered one circuit that would be equivalent to one pair of wires coming into his location.

Obviously, with fiber you cannot order service like that. Users are being forced to consider greater groups of services: voice and data or maybe just data, maybe just voice.

For the small potatoes kind of guy, throwing the service entirely on the fiber doesn't have a lot of application. For the larger user, there is an implication of wide bandwidth service being brought into his business. Now, he can pump out literally hundreds of times more data then he could have in the past.

What are the different challenges for moving voice and data in a digital environment?

First of all, there is the interface. You have to be able to interface with the digital network. In the past, the interface has been aimed at the analog network.

However, the most significant challenge right now is that digital services are not being priced for the medium-size to small user. The challenge is an understanding of where the line is. Where do I have enough services to acquire the use of the digital network?

I guess the bottom line comes down to economy. Where is the economy scale vs. the efficiency scale? In other words, saying that I have the digital network is well and good, but you have got to bring it back down to the bottom line and ask, "Where is the justification?"

How long will it be before the Bell operating company local loops are digitized?

I think that is coming very quickly: That is imminent. That is here in many cases in the types of cities I mentioned earlier.

What does that mean to home telephone users?

I would say to the home telephone user that it is probably not significant. Certainly, there is not any significant difference in the application that the home user has now.

But the bandwidth that digital media offers can bring in potential for very high-speed data communications, possibly video-type conferencing from the home, things of that nature over the bandwidth here.

I think the application that you are going to see from the digital network to the residential user is not going to be as application-driven as it is going to be cost-driven. The initial benefit will be to the operating companies with regard to long-range economies. But then that is going to invite potential uses for the residential subscriber.

What do digitized local loops mean to business communications users?

Just what I mentioned earlier. It is here now only to business and is more of an economic benefit to the large user.

Let's use the digital subscriber with a digital interface and a [private branch exchange] as an example. In the past, this person has possibly been sending his data over a digital network such as the [digital data service]-type circuit. And he has an analog connection from his digital PBX to the analog network.

Now, he is going in a digital environment from the PBX to a digital loop. He has the possibilities of sending everything in a digitized format, so that voice now becomes data. He can literally share the circuits that he has, thus leading to economies.

Now, you have digital switches talking to other digital switches, so you have the combination of economy benefits and speed benefits and more integrity in your data that you sent. And you have voice and data terminals that are literally on the same network.

How many all-digital PBX pieces are currently in use, and how long will it be before they become widespread?

You have to qualify what you mean by an all-digital PBX. There are thousands, upward of 50,000 to 60,000 digital PBXs in the U.S. But what good are they doing on an analog network externally? In other words, you still have digital going to analog to talk over the network.

When I say 50,000 to 60,000, I am throwing in AT&T's Dimension PBX, which technically is not a digital PBX. But if you take Northern Telecom, Inc.'s SL-1 system, which is digital, the [Rolm Corp.] CBX, which is digital, and then the new guys on the block — the [Intecom, Inc.'s] and the [NEC America, Inc.'s] and things of that nature — you have thousands of them. However, they are not interfacing with the network in a digital format.

What is their advantage to users in an analog environment?

It is twofold. First, it is less expensive for a manufacturer to make a digital switch than an analog switch. So you have an economy coming out of the warehouse.

Why is it less expensive?

The technology is less expensive. The printed circuit board environment — to eliminate the conventional relays and connections that are required in an analog format — is not required in the digital switch. It is just cheaper. So you have economies coming out of the warehouse.

Second, you have the sound argument that you can internally switch digitized voice and data over the same pair of wires. You can realize the economies and benefits of using common cabling for voice and data.

The argument of whether or not a digital PBX is superior to an analog PBX — and the Bell System waved this flag for years with the Dimension — was that to the telephone user calling out on the analog network, there has been no benefit. But that is changing with the coming of the digital network.

How long will it be before integrated services digital networks appear, and what will they mean to voice and data users?

The appearance, again, is imminent. Certainly, within the next two years, we are going to start seeing a wide influx of ISDN. This is going to mean an expansion of what we are now calling the local-area network to a wider range, more remote-type connection.

What are the long-term prospects for the modem industry in an all-digital environment?

I certainly do not think that they are as strong as they have been. The concept of the modem itself does not fit into the digital network. However, there are modem-type devices — black boxes — required for connection even when you go digital to digital. Modem manufacturers are probably the ones that are the most likely candidates to be providing these types of black boxes.

Why will they be needed? What tasks will they perform?

You have various transmission and data-rate sampling mechanisms that — even when you go from a digital to digital environment — are not always the same as the North American network standard.

I think the Rolm CBX is a good example. Its sampling rate is different from the North American network, so there has to be some type of box that makes the digital signal that the CBX is sending out compatible with that network.

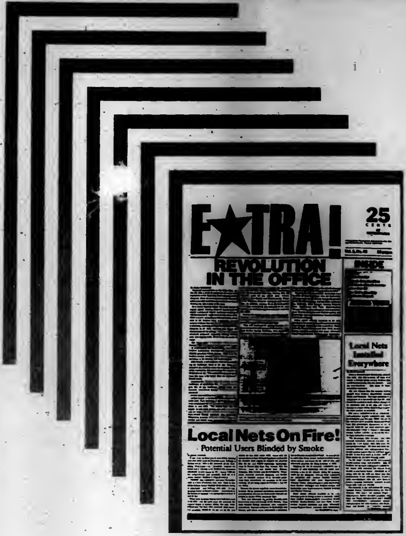
That is not the long-term answer for the modem manufacturers, but that is the type of market they may go to.

How will the PBX vendor picture change within a more digital environment?

For all practical purposes, the analog switch is a dead animal. I think AT&T has substantiated that statement by introducing its digital line of PBXs. Back when the Northern Telecoms and the Rolms of the world were first introducing digital PBXs, they were waving the flags that digital was better. But, again, to the plain old telephone system user, it was somewhat difficult to quantify.

With the digital network, obviously the digital PBX makes more sense. You are going to find more integrated services going out over the digital network, and I think the analog PBX is virtually a dead animal.

You can pick out some applications. For example, the Ma-and-Pa hotel out in a rural area may decide to purchase a new analog switch, but for all practical purposes, it is dead. ■



LOCAL-AREA NETWORKS: MORE SMOKE THAN FIRE?

BY JOHN KING

Local-area networks, token rings and Ethernet: Everywhere you look these days you read about the marvelous new technology that is going to revolutionize the way computer systems are built and how offices of the future will be wired. Advertisements claim that several thousand local-area networks of this or that type are installed.

King is director of James Martin Associates, Inc., a telecommunications consulting firm based in Carmel, Calif.

Market researchers claim that the local-area network market is already running at $1 billion per year and will grow to many times that size over the next five to seven years.

But potential users still have questions: "When do I need one?" "What will a local-area network do for me?" This last question is the key. Most discussion of local-area networks has addressed network topologies, cable characteristics, link protocols and their efficiency or the cost per connection. Eventually, the person paying for a local-area network will want it to do something, whatever its physical characteristics.

What is the status of the development and use of local-area networks? Figure 1 on Page 44 shows the relationship between the number of papers and articles published on any given subject, indicated by the solid line, and the number of installations and presumed use of whatever was being written about, whether digital private branch exchanges (PBX), distributed processing or local-area ▶

networks. Notice that when the number of articles goes up sharply, the installations are just beginning. Also notice that as soon as the number of installations begins to accelerate rapidly, the number of articles written drops off sharply, and as any journalist will tell you, old news does not sell.

Currently, the number of articles that are being published on local-area networks is about halfway up the steep rise. Therefore, the point where local-area nets are going to take off in the market has not even been approached.

Notice that when the number of articles published on any given subject goes up sharply, the installations are just beginning. In addition, notice that as soon as the number of installations begins to accelerate rapidly, the number of articles written drops off sharply, and as any journalist will tell you, old news does not sell.

But how can this be reconciled with the claims of certain vendors that they have already installed thousands of local-area networks? It is necessary to recognize that there are two completely separate categories of local-area networks.

First, there are those that a vendor uses to tie together its own set of computers and other devices. This category involves a private network that is not intended to be used for the easy interconnection of other vendors' equipment.

The second category involves a network installed for the purpose of interconnecting different types of equipment that may or may not be from multiple vendors.

The fact that Datapoint Corp. and Xerox Corp. use network technology that can be applied to networks of the second category only obscures the fact that most of these networks were installed simply to tie together their own equipment.

IBM could just as easily claim that every 8100 sold represented a ring-type local-area network or that every System/34, System/36 or even 3274 represented a star-configured local-area network.

Of course, Ethernet has become the prototype for open networks and has more than a hundred vendors supporting it around the world. Datapoint belatedly discovered that its Arcnet coaxial cable network should be called a local-area network, even if it uses a bastardized version of Synchronous Data Link Control for its link protocol.

Local-area networks, or even wide-area networks, allow complex systems to be built out of separate processors and other devices.

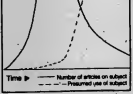
One way to think of a local-area network that connects multiple small computers and peripherals together is as a complete computer system. A processor has been dedicated to each user, and a network is used for sharing data or allowing a user to reach certain peripherals.

In the past, these same functions were performed on a single processor that could keep track of multiple tasks, could provide for multiple paths to the data files and could allow for sharing of peripherals. The functions remain the same, only the architecture has been changed.

But the state of the art for local-area network systems is roughly the same as it was for the larger shared systems segment 20 years ago.

Most of the local-area networks installed today perform a limited set of functions. These include the sharing of a printer, the sharing of a hard-disk system and simple electronic messaging. What it comes down to is basic file-transfer operations.

This worked well for such companies as Nestar Systems, Inc. and



Corvus Systems, Inc., as long as large disks and letter-quality printers were still relatively expensive.

Now that the basic $5,000 personal computer comes with a hard disk, and near letter-quality printers are inexpensive enough for one to be in each office, the market shares for the products offered by these companies are slowly declining.

But the market itself will not go away. Such networks will continue to be popular in schools and small businesses, where there is sufficient density of small computers and a community of interest that allows for the sharing of information and of relatively inexpensive peripheral devices.

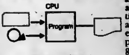


Figure 2. Phase 1

From whatever direction we look at local-area networks and the local net marketplace, we keep coming back to the lack of functions that is preventing rapid expansion of the local-area network market.

Where functions such as file sharing or electronic mail are being provided by a vendor, it is most often the case that the implementations are totally incompatible with all other implementations in the market. This results in a closed market opportunity for one vendor, but it also results in a damper on the market in general.

An example of this is the new Personal Computer network from IBM. Access to the network is apparently controlled by a proprietary software system that is embedded in the read-only memory that is part of the adaptor card that must fit into each Personal Computer on the network.

But it goes further. The software that runs in the individual Personal Computers that allows redirection of commands for a disk or a printer to another Personal Computer on the local-area network, or allows that other Personal Computer with its internal disk and attached printer to act as a local-area network server, is unique to this product from IBM.

Although other devices may share the same cable, that does not necessarily mean that they can interchange information with an IBM Personal Computer using the Personal Computer network software. We are beginning to discuss network compatibility just as we have discussed the various levels of compatibility with IBM's Personal Computers during the last two years.

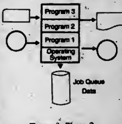


Figure 3. Phase 2

Large computers, which became known as mainframe computers or minicomputers, have gone through four major phases of evolution.

The first computers could be dedicated to handling a single problem at a time. A program would be loaded and run to completion before the next job would be loaded (see Figure 2).

In the second phase, an operating system was provided that allowed one job to succeed another without the necessity for operator intervention (see Figure 3). The ability to process more than one program at a time under that same operating system was also added.

During the time that the computer was waiting for an operation in the first program to be completed, the system resources would be dedicated to a second program. Both of these advancements came about to encourage more effective use of available time on these expensive computers. More programs could be run by using automatic schedulers and multiprogramming.

The third phase involved using terminals to allow multiple users to interact directly with programs in the computer (see Figure 4). This phase began in the '60s, exploded in the '70s and became the normal mode of operation in the '80s.

Because so many resources are dedicated to the operating system that schedules the individual online users and keeps their data and programs separated, it has proven to be more effective to use smaller computers, that is, minicomputers, for much of this timesharing than to use large mainframe computers.

Data communications networks increased in importance as more and more computers were dedicated to on-line applications. Today, data communications is almost as complex a field as computers and operating systems themselves.

The fourth phase of computer evolution has been in distributed, networked systems (see Figure 5). The best example of this today is in systems supplied by Tandem Computers, Inc.

An on-line user will request information or request that a program be run. The user is not aware of where the data is located or which processor in what location actually runs the program. It is possible for the program to run in one processor at one point and in another processor at a different location later.

To accomplish this, the network has now been absorbed into the computer and operating system environment.

With microprocessors and desktop computers, we are seeing a similar pattern to the one that we saw with mainframes and with minicomputers: Ontogeny recapitulates phylogeny.

However, with each smaller type of system, the generations come more quickly. Desktop computers are moving rapidly from single-user, single-tasking systems toward multiuser and multitasking systems.

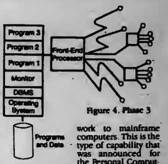


Figure 4. Phase 3

The networking technology required to link multiple desktop systems — that is, multiple users — together is different from what is now referred to as wide-area networking. Local-area networking is characterized by short distances and very high data rates, as well as certain other characteristics.

The principal difference between how personal computers will evolve differently than mainframes and minicomputers is that, right from the beginning, there are multiple desktop computers in almost every organization.

This means that the distributed network model that has taken so long to evolve in the world of large computers will come very quickly into the microcomputer arena.

Software is the area in which changes will have to be made. Most software written for Apple Computer, Inc. or IBM microcomputers is written for operation by one user at a time.

Now that IBM has announced Microsoft, Inc.'s multiuser operating system Xenix for a model of the Personal Computer family, a great deal of applications aimed at supporting multiple users can be expected.

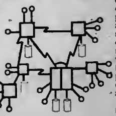


Figure 5. Phase 4

The real challenge, however, will come in developing truly distributed systems, where the user sitting at a desktop computer will request information, and that information will arrive without the user being aware of its source. Using local-area networks, multiple desktops will perform with each other and, through gateways, will be interconnected to mainframes.

The first step along the route to fully networked systems was the use of personal computers as dumb terminals. This was followed by the introduction of simple local-area networks to allow data files to be transferred from one system to another.

The next step was shared peripherals via local-area networks, and this was followed by more sophisticated micro-to-mainframe links, including 3270 emulation.

Already there are direct connections between software packages that run on personal computers and major software packages — usually data base management systems — that run on mainframes.

The next step will be use of gateways between local-area networks and wide-area networks for connection of multiple personal computers on the local-area network to mainframe computers. This is the type of capability that was announced for the Personal Computer network with the 3270 emulation package.

It should be pointed out that these steps are not always sequential. It is sometimes necessary to take separate steps forward and then combine them in the future.

For instance, the Xenix multiuser system announced for the IBM Personal Computer/AT will not work over the Personal Computer network as it has been announced. If IBM does not let this be known, perhaps Microsoft will do so.

In the same way, the IBM Topview windowing packaging will not initially run with the Personal Computer network, although IBM has indicated in a statement of direction that that will be rectified in the future.

Several years from now, when desktop personal computers are capable of operating at one million instructions per second (Mips) or more, the software packages for full networking of personal computers will be available.

And just as with mainframes today, probably 50% or more of those Mips will be dedicated to operating system functions including distributed data base management, dynamic resource allocation and sharing and transparent use of multiple organizational wide-area networks.

When there are few articles about local-area networks, and when those that do appear no longer advocate a particular link protocol or transmission medium, we will know we have reached that point.

We will have moved on from issues that relate to the lower levels of the International Standards Organization's Open System Interconnect reference model, meaning the transport mechanism, to those issues that directly affect how one application interfaces with another application.

But have no fear. By the time we have gotten to that point, there will be two more topics that promise to provide those of us who write or give seminars or provide consulting plenty of opportunity to continue to espouse our favorite points of view. ■

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LOCAL-AREA NETWORK INTERFACES

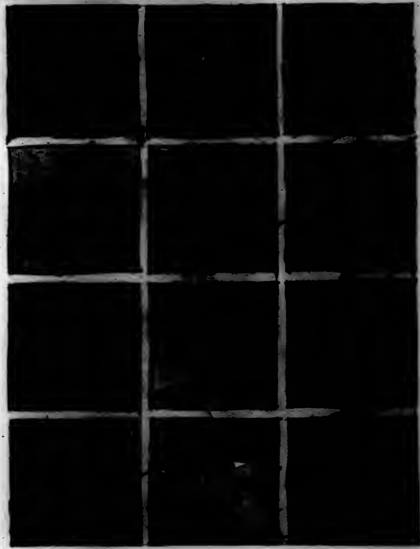
BY KEN KRECHMER AND DON R. PICKENS

It is now widely accepted that a full-scale evolution toward personal computing is well underway. Under a variety of guises, which include workstations, intelligent terminals and even intelligent telephones, personal computing is rising to meet the needs of an ever-increasing base of small business and professional office workers. Concomitant with this rise is a growing need for the ability to gain access to all types of communications services.

Both nationally and internationally, much effort has gone into the definition and standardization of communications technology with regard to protocols and protocol architecture. Little effort has gone ▶

(Continued on Page 50)

Krechmer is a principal at Action Consulting, Sunnyvale, Calif. Pickens is network product architect for Visicorp, San Jose, Calif.



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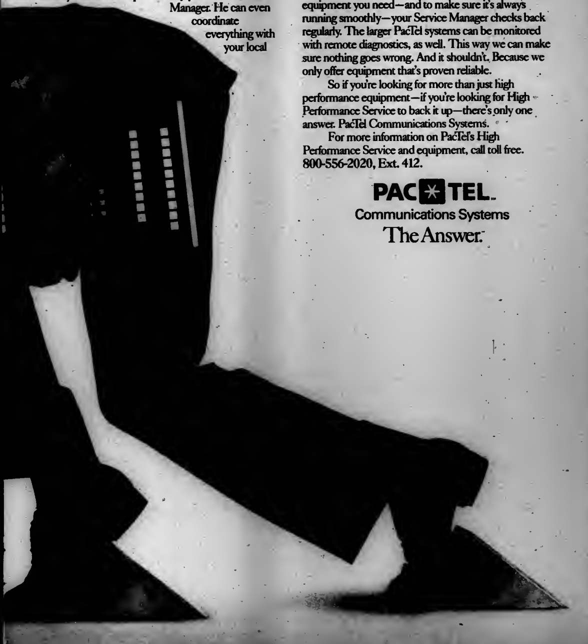

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into defining standard interfaces, especially interfaces to foster portable software development.

Professionals from other technologies, such as graphics, have reaped the benefits of standard interfaces. These benefits include allowing designers to concentrate on enhancing applications and encouraging competition based on quality and price rather than on features and transferring knowledge between applications and the environments of those who implement systems.

Personal computing provides computational capabilities to an individual in a dedicated, single-user configuration. There are numerous physical embodiments of this definition. However, there are deviations, such as multiuser small business systems. The single-user view, however, represents a common and increasingly popular trend in the industry.

The combined leverage of lower cost hardware, increased functionality and end-user sophistication has accelerated the adoption of personal computing. These trends make the marketplace profitable and dynamic, and the ultimate winners will be the users.

Applications for personal computing have been wide and varied, but have focused especially on spreadsheet, word processing, data base management and graphics. Communications applications also have begun to appear, such as terminal emulation, mainframe data base extraction, local network print spooling and transparent disk sharing. A majority of these applications have been nonintegrated — in that they have subsumed most of the host machine's resources — often overriding functions provided by the operating system and requiring reloading of program diskettes.

Fortunately, integrated environments have begun to appear, as has an increased capability for software portability to new machines and environments.

The focus on protocols by the standards community has led to important multisystem compatibility for minicomputers and mainframes. For these, the need for standard portable software has been relatively insignificant, as very few standard installations were ever seen. The reverse is true of personal computing, and as machine shipments continue to outstrip those of minis and mainframes, the need for standardized software interfaces is greater than ever.

In some respects, the available technology for personal computing has begun to rival that traditionally available for minicomputers. Except for demand access virtual memory, most of the capabilities already exist. It is not uncommon, for example, to see the introduction of technology with a minimum configuration of a 16-bit micro, a 256K memory, local 5M-byte hard disk, bit-map graphics and high-resolution printing device for input.

Advances in communications technology have paralleled the advances in personal computing technology. Modem functions have been reduced to a single chip, and local-area network interfaces have been reduced to a few chips. Link speeds of up to 1.2K bit/sec for analog, 64K bit/sec for digital circuit switching and 10M bit/sec for local-area networking are all common and affordable.

What is difficult for the systems developers, and not apparent directly to the end users, is the diversity of options for layering and packaging communications functions in both hardware and software. The end user eventually feels a negative impact, however, if applications are not portable.

The primary trade-off concerns whether to package functions in the application, operating system, system board or external black box. Good examples of each of these choices can be found for every technology. The difficulty for the user is that the interface is not standardized in any of these physical parts.

So the user must stay locked in to single solutions, with little hope of expansion. What makes the problem difficult for the applications designer is that portability and flexibility are difficult to achieve both between processors and between alternate functional parts.

Some of the factors that may influence systems designers to make these kinds of trade-offs include the following:

- Conserving hardware cost and maximizing flexibility for applications software;
- Improving performance for operating system software;
- Recapturing lost memory and processing cycles for system hardware;
- Protecting hardware and software from impact via emulation of and between alternate functional parts.

The combined leverage of lower cost hardware, increased functionality and end-user sophistication has accelerated the adoption of personal computing. These trends make the marketplace profitable and dynamic, and the ultimate winners will be the users.

For certain applications, the potential for unattended operation and concurrent processing capabilities is additional motivation for black box configurations. Both of these capabilities reflect technological inadequacies in many personal computing systems today: That is, they require frequent rebooting or must be powered up.

If an end user can make these trade-offs freely, then he may optimize cost or performance. If standard interfaces exist, the systems designer can offer applications independent of the actual configuration chosen. These goals cannot be achieved without standard interfaces and service specifications.

Communications applications require a foundation of implemented services, usually modularized and layered. In traditional design for mini- and mainframe-hosted applications, this foundation often becomes many layers thick and often is inefficient in operation.

While sufficient for previous global, medium-rate communications environments, this layering is rapidly becoming insufficient in two ways.

First, in high-performance local networks (with speeds of 2M to 10M bit/sec), layering limits maximum performance to a small fraction of the total available bandwidth. This performance limit is due not to transmission line overhead, but rather to software overhead. Second, at the low data rates within the direct distance dialing (DDD) network, transmission line overhead becomes unacceptable.

Protocols and interfaces should be specified together, though they often are not. Protocols specify the data streams and signals that would be seen if a transmission line were examined by a data analyzer. Interfaces specify the functions and data formats across a service boundary local to the end points of the data flow.

Several service layers appear in well-designed communications systems. In practical use, only a few of these layer boundaries are evident. These include:

- *Application layer:* Application-specific communications functions, such as electronic mail submission and delivery;
- *Transport service:* Establishment of end-to-end contact, movement of data, connection and connectionless data transfer;

A Look at Modems: The Rhyme

Knowing the reasons for and function of the RJ-11 interface as the physical interface to the DDD system allows an examination of the required higher level interfaces. The media access interface between the RJ-11 and the digital personal computer is called a modem. The modem has a separate digital physical interface — EIA Standard RS-232-C.

The RS-232-C physical interface between the modem and the microcomputer has been a source of many problems. While the RS-232-C standard specifies signal types and functions, many manufacturers have not supported all signals required or have not followed the signaling protocols originally developed by AT&T, which are not described in the RS-232-C standard. Some of the problems were generated by AT&T itself by changing signaling protocols on different modems. These problems have caused incompatibilities, which are often compounded by incorrect cabling between the modem and microcomputer RS-232-C physical interfaces. At this level, physical interface problems can be solved without user interaction by the development of smart RS-232-C interfaces that sense the leads used and that control them accordingly.

Up to the mid-'70s, the most common modem was a 300 bit/sec device developed originally by AT&T and referred to as a 103. Then, AT&T announced the 212 modem. The 212 can transfer data at four times the rate of the 103, or 1,200 bit/sec. Another key feature of the 212 was the ability to communicate with 103 modems. This high-speed, downward-compatible modem has become the standard media access method to the DDD network.

Given two widely accepted physical interfaces and the standardized 212-type modem for media access, there now is an emerging requirement for standardizing the next level of interface — the transport service.

Standard modems such as the 212 might be described as dumb modems. They function simply to provide media access to the DDD network. Dumb modems perform such functions as modulation and demodulation, modem handshaking and the RS-232-C interface functions. They do not engage in transport service tasks, such as autodialing, call-progress sensing, alternate routing and so on.

Modems that begin to perform transport service tasks have recently emerged. These modems might be referred to as medium-smart modems. They perform all the functions of the dumb modems, with additional functions such as the logic to decode the data stream as commands for the purposes of autodialing, the ability to sense the telephone line call-progress signals and the logic to implement software-controlled options that can be used in place of switches or straps to configure the modem for specific applications.

■ *Media access:* Physical link procedures, modems and local net boards;

■ *Physical interface connectors:* RJ-11 and Ethernet connector.

Requirements for standardization at the connector interface level seem well accepted, but largely ignored at the high layers.

The broad acceptance of the DDD network for data communications can be traced to two fundamental reasons: First, the DDD network is everywhere, and, second, it works.

These are two compelling arguments for expanded use of data communications on the DDD network. However, in the last 10 years, a considerable number of questions have been raised about what form the DDD network will take.

During this time, a number of industry pundits have prophesied the demise of the analog DDD network, pointing out that the technology is capable of providing better service, if the network were fully digital for voice traffic as well as data.

While these prophesies are accurate, they direct their analysis to the network's format, not the network's interface. From the users' and manufacturers' viewpoint, the most important definition is that of the interface, not the format. During the same period that the DDD system has implemented a more digital format, the regional Bell operating companies have also developed a standard physical interface that is analog.

The most common physical interface to the communications network today is the RJ-11 connector interface to the DDD telephone system in the U.S. and Canada. The use of this interface is expanding dramatically for a number of reasons.

First, because of the tremendous surge in worldwide requirements for voice communications during the last 20 years, a large volume of hardware and circuits has been installed that are analog at the user RJ-11 interface. Thus, the base of analog interfaces has not contracted, but expanded worldwide.

Second, many new services are being offered via the current analog interfaces. MCI Communications Corp., GTE Telenet Communications Corp., Tymnet, Inc. and others use telephone company-provided DDD circuits to link dial-up subscribers to their value-added or more cost-effective services.

Ten years ago, AT&T-developed standards were often at odds with CCITT standards. Now, even AT&T recognizes the need for compatibility. This emerging worldwide standardization of interfaces and access offers users the potential to transfer data to their counterparts anywhere.

These companies are all expanding their support of DDD users and are thereby expanding both the features offered via analog interfaces and their capital invested in DDD line support. While the backbone or trunk connections of these services are predominantly digital, in order to reach a broad range of subscribers, even the most technically advanced services extensively use DDD circuits with analog interfaces.

Third, the number of standards and standards programs that allow greater use of the DDD network is increasing. In Europe, organizations such as the Consultative Committee on International Telephony and Telegraphy (CCITT) are taking stronger positions in terms of developing standards that are being embodied in products both from the U.S. and the rest of the world.

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While this capability is not here yet, it is coming. Registration programs sponsored by the Federal Communications Commission and the Terminal Attachment Program in Canada have stepped in to create standard interfaces for all devices that connect to the DDD network. These programs have been successful, allowing users more choice at lower cost.

Fourth, there is a growing trend among organizations to allow employees who can function effectively at home to work there. This expands the use of the DDD network both in the employee's organization and at home.

Fifth, the recent AT&T breakup would appear to have had the effect of slowing down the introduction of new digital subscriber loop services. This is due to the greater difficulty of coordinating such changes among the various Bell companies and the need of each Bell company to expand its capital resources more carefully due to new postdivestiture capital requirements such as sales organization, development and marketing.

Given these five trends, it is reasonable to expect that voice bandwidth-limited RJ-11 interfaces to the DDD telephone network will be the most common interfaces for the foreseeable future, even taking into consideration the emerging trend toward all-digital local loops. Now, the data communications industry must work to make data communications simpler via the RJ-11 interface (see story below).

As personal computing continues its explosive growth, two needs demand increasing attention — adequacy and portability. Portable software — which can be migrated across hardware vendors, operating systems and applications — requires standard interface definitions and service specifications.

User-acceptable software requires a foundation of adequate services underneath. The DDD network is most pervasive and has been in existence the longest, yet it seems to be the least standardized, except at the levels of physical interface and signal modulation.

The following functions and services are required in the media access and transport layers of tomorrow's communications products in order to implement fully DDD interfaces to personal computers:

■ Full command sets allowing the control of all possible DDD functions;

■ Automated controls and RS-232-C configurations to eliminate the current requirement that the user learn data communications jargon in order to make his modem work;

■ Complete sensing of call-progress tones;

■ Simplistic logical interfaces to the personal computer to allow easier programming of communications applications.

With the implementation of this complete set of functions, applications software packages will be developed that can transfer electronic mail, charts, files and graphs throughout the U.S. and Canada via applications protocols layered atop hardware that provides sufficient access to the services of the DDD network.

If standard interfaces can be achieved for the DDD network, then the personal computing evolution can continue unabated. If not, then growth may be stunted. In either case, the lessons learned in designing portable software for the DDD network will be directly transportable to the future of all digital networks. ■

and Reason of the RJ-11 Interface

Transport service functions require specific capabilities in order to function over the broad range of DDD services available or planned.

In the U.S., DDD uses a maximum sequence of 11 digits and a minimum of seven. These digits provide both billing and addressing information. As companies such as GTE Telenet Communications Corp., Tymnet, Inc., MCI Communications Corp. and others develop more communications systems using the DDD network as an input, more dialing requirements develop.

These services require call-routing information, billing information and security information to prevent unauthorized use. These functions currently use up to 10 digits. In addition, credit card calling is being promoted by the individual telephone companies. Credit card calling requires a sequence of 14 digits for billing purposes. Other services can be expected to develop that will require addressing, billing and security information, and additional control might be desired — for example, message class, transmit speed of message and so on. With this in mind, medium-smart modems have a requirement to support an autodialing digital field that is at least 30 digits long, not counting control codes.

Call-progress sensing is another part of the transport service function. Currently, the dial-up system uses broadly defined tones to announce call progress to the originating party. First, the dial tone indicates that the network is available for dialing. The loss of dial tone indicates that the network has accepted the first digit. Voice intercepts at this point define a need to redial or to verify a number. Remote ringing indicates an attempt at call completion. In modems, after remote ringing, the generation of answer tone starts the data handshake and indicates that the dialing sequence has ended successfully. This is the simplest transfer sequence, since both the addressing and billing information occur in a short and continuous message. More complex sequences emerge when calling with a credit card or using the existing DDD interfaces to facilities of MCI, Telenet, Tymnet or others.

Call-progress sensing is currently at a rudimentary stage in available autodialing modems. Only a few of the call-progress signals — dial tone, busy tone, voice intercept and remote ring — are sensed, or the allowable sensing sequences enable only the simplest DDD calls to be made. Modems with more powerful call-sensing routines will undoubtedly become available soon. While standardization of a transport service interface is unlikely in the short term, there is a trend, both in hardware and in microcomputer communications software, to support multiple interfaces — as soon as they can be defined — to minimize user problems.

— Ken Krechmer and John R. Pickens

LOCAL NETTING THE WAY TO PRODUCTIVITY

WENTZVILLE, Mo. — Factory automation, so they say, can make production so efficient that employees have time to stand around the water cooler reliving war stories and recounting fish stories. And for an automobile assembly plant located here, a local-area network has become a crucial element toward the goal of improving productivity and profits through modern electronics.

The U.S. automobile industry has recently risen above its unprofitable past, but automobile executives realize that a commitment to factory automation and computerization is crucial to their economic health.

General Motors Corp. recently chose a broadband local-area network for its new assembly plant here that is demonstrating favorable results. Since the plant has a wide variety of advanced electronic equipment and will add more in the future, GM wanted to maximize this equipment investment by linking it together through a local net. But it had to be designed so new equipment could be easily added.

Another GM requirement was that existing equipment must have the ability to be moved without complicated, expensive rewiring. This reflects a basic characteristic of automobile assembly plants: With the yearly model change, equipment is moved to another location in the factory. The broadband local net now used at the plant meets all GM's requirements.

Local-area networks were introduced to the automobile industry about a decade ago; one of the first broadband local nets was installed ▶

in an Oldsmobile plant in 1973. However, a GM spokesman admitted that, in the past, broadband networks did not live up to their potential because of problems with reliability. But this is not the case at GM's plant here.

The local net was installed in the new plant about two years ago and is a product of Sytek, Inc., a supplier of broadband-based local networks. About eight GM sites across the country now use Sytek's Localnet 20, with more to be added in the future.

According to David Fernandes, GM's senior supervisor of process control at the Wentzville site, his plant originally had planned to use dedicated twisted-pair cables to link together process control equipment, terminals and other devices on the factory floor. However, Fernandes had been introduced to the Sytek broadband products while working at GM's plant in Fremont, Calif., and was impressed with them.

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Localnet 20 connects each user device to a broadband cable through a network interface device called a packet communications unit. Each packet communications unit is a complete microprocessing system consisting of an advanced semiconductor device that executes Sytek's proprietary communications software and a broadband modem that converts digital data to analog form for transmission between packet communications units.

This system, Fernandes said, fits the needs of the factory setting. "We can configure a box to any piece of equipment we want. The system is extremely agile."

One of the advantages of broadband technology, which offers multiple data channels on one coaxial cable, is that new ports can be added inexpensively and easily. A new port can be accommodated on the Localnet 20 by simply adding a short piece of cable to the trunk. It is far cheaper and often quicker to add a terminal to a broadband local network than to pull new wire for a twisted-pair network, Fernandes said.

He recalled one problem in which a user needed a terminal/printer out on the plant floor. "He wanted it immediately so that he could more closely monitor a process. We had his terminal up and running in an hour. A technology other than broadband would have taken much longer," Fernandes said.

Not only is the Wentzville network dynamic, it is also rapidly growing. When the plant first put in its local network, there were 100 ports or user-connected devices. The network has since been expanded to 200 user devices as "other applications came along," Fernandes explained. Among the many types of user devices populating the network are electrical testers, vehicle component verification systems and programmable controllers for turning equipment on and off.

The vehicle component verification system located on the factory floor is made up of testing stations that communicate through the network with an IBM Series 1 minicomputer located in the DP department's computer room. Attached to the Series 1 is a Localnet 20/200 eight-port packet communications unit that provides eight network connections. A Localnet 20/100 dual-port packet communications unit is located at each vehicle component verification system test-station. One of the 20/100 ports is linked to the test device — a bar code reader. The other is linked to a printer.

Part numbers are picked up by the bar code reader and sent back to the Series 1. There, the field number is compared against a data base and verified as the right part for that particular car. The result is sent back to the remote printer.

In addition to the many factory automation applications, Wentzville has allocated six color television channels on the broadband local network for video applications. In addition, the plant runs

its energy management and control system over the network. In that application, a Digital Equipment Corp. PDP 11/44 minicomputer is at the heart of the system. It communicates to various control devices in order to keep careful track of costs associated with heating, lighting and air conditioning. From remote terminals, the users are able to check into the status of any of the energy management devices as well as communicate with the host via Localnet 20.

THE GM PLANT IS considering yet another application. This would involve the use of protocol converters with Sytek modems connected to DEC VT-100 terminals to allow access to the IBM mainframe for monitoring time and attendance and handling materials control applications.

Fernandes reported that he has attended meetings at other GM assembly plants to discuss his experience with broadband technology.

The Wentzville plant employs 3,000 people and is designed to produce 75 cars an hour. Buick and Oldsmobile models are assembled there. Since it is a new plant, it was built to promote efficiency and economy, using a wide range of electronic equipment and industrial robots. The plant's data processing and engineering departments must contend with rapid changes in factory automation, such as the addition of robots and interactive workstations.

So far, the network has easily kept up with these changes. "The Sytek equipment allowed us to do some special things because we could alter the communications features, such as bit rate and line characteristics in the modem," Fernandes said. "We have been able to adapt almost any device to the network. I have not found an application within the process control world that I cannot accommodate."

For example, the plant currently has an application that uses an IBM Personal Computer/XT. "We created our own software program for the XT," he said. It is used to handle the maintenance dispatcher's log book. That log covers four departments: paint, trim, chassis and body. The personal computer is located at the main dispatch area where data is entered. This data includes the time of the dispatch, whether the problem was fixed and other related information. Each department has quick and easy access to status reports by reading the output on the printer located in each department. All the devices are interconnected over the broadband local network.

Broadband networks are based on the same technology as cable television. The multichannel feature of the network is achieved through the use of frequency-division multiplexing. Frequency-division multiplexing allows different services such as voice, video or data to share the same cable at the same time. Sytek's Localnet frequency-division multiplexing approach defines up to 120 separate channels within one coaxial cable. These channels are often referred to as subnetworks or subnets. Sytek also provides bridges to interconnect all or some of the channels on the various subnets to form one large Localnet 20 network.

Each subnet on the broadband cable can support hundreds of user devices that can be interconnected as an independent network or as part of a larger network.

Another feature of broadband technology is its wide geographic coverage. Localnet 20 is capable of covering up to 35 miles. That is far more expansive than other major local-area network technologies, such as baseband and private branch exchange. Since GM's Wentzville plant covers 80 acres under one roof, wide coverage was not a requirement of the network. However, other Sytek customers such as Brown University and Kodak Corp. found that feature useful.

While expansive geographic coverage was not a requirement, high reliability and low downtime were. According to Fernandes, the network has needed "minimal" maintenance. As for downtime, "our [local-area network] has not been down yet," he reported. Reliable transmission is also a consideration. Localnet 20 addresses that issue with its high-level communications protocols that include error detection and correction features. Another advantage is broadband technology's high immunity to random noise generated by factory equipment.

The network's ability to serve future applications is an important requirement. One of these future appointments, Fernandes said, involves stand-alone minicomputers that are currently being used as dedicated electrical testers. In the future, the programs for these testers will be maintained in another computer and linked to each tester through the local net. This change reflects a basic long-range goal: namely, including all electronic equipment and systems in a network, thereby facilitating the universal flow of information.

GM, like other corporations, is eagerly embracing the trend of using intelligent machines in industrial settings to assist the work of man. By linking these machines through a local-area network, companies will be able to control factory performance and costs, improve scheduling of work and maintenance, use machinery more efficiently, monitor machine performance more closely and create better reporting of results.

This will lead to the efficient production of quality products that will be more competitive in world markets. Such a goal is crucial if U.S. industry is to maintain leadership during the '80s and beyond. ■

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Tool Provides Micro-Host File Transfer in Multiple Modes

A software package that provides micro-to-mainframe file transfer in multiple modes has been unveiled by Pathway Design, Inc.

Pathway Design BSC-RJE reportedly provides micro-to-mainframe file transfer in IBM 2780 or 3780 remote job entry-emulated modes and remote micro-to-remote micro communications in a 3780-emulated mode.

The package lets personal computers transfer files to and from IBM hosts in Systems Network Architecture (SNA), Synchronous Data Link Control (SDLC) and Binary Synchronous Communications (BSC) environments.

While resident in a designated personal computer, the package allows the micro to act as a collector. It receives or transmits data to and from remote personal computers. Data is then transmitted via dial-up and leased lines to and from the host in a batch mode. This personal computer networking system reduces the number of lines to the host during micro-to-host communications and allows users to transfer a variety of files, including Ascii text files, executable images, data files and JCL commands.

The package offers additional features, including the ability to maintain a host session in an unattended mode, support of wildcard characters for file concatenation and a message file that logs all events on a diskette file during unattended transmission.

And there is the ability to access local applications and DOS facilities through user exits without terminating a host communications session. Other features are: multiple concurrent print support, host-initiated printing, data capture on diskette and line speeds up to 19.2K bit/sec for SNA or 9,600 bit/sec for BSC.

The firm also announced the Communications Adapter, which is a multifunction, dual-channel board that plugs into an available personal computer expansion slot to attach to networks using SDLC or BSC protocols over leased and switched lines. An adapter cable allows the adapter card to connect to a modem or modem eliminator.

The Pathway Design BSC-RJE package is offered at $595, the Communications Adapter at $295 and the adapter cable at $50.

Pathway Design, Inc., 177 Worcester St., Wellesley, Mass. 02181.

Test Set Measures Voice Frequency Lines

Atlantic Research Corp. has unveiled a level-noise-frequency test set that measures the characteristics of voice frequency lines and a patching and switching system said to activate and monitor spare or off-line equipment.

In addition to measuring voice frequency lines, the LNF-3 test set reportedly offers a voice intercom feature that allows the coordination of activities with a field location using the line under test for transmission. Also included is an audible monitor, a variable fixed-signal generator and dual-display of level and frequency.

The DPS-5 Data-Patch reportedly activates and monitors spare or off-line equipment. The system provides crossover switching, accessing, testing and monitoring for all primary circuits and for off-line backup equipment as well. High-priority data lines are established to the user's primary equipment. Low-priority data is routed to the user's backup equipment. In the event of an equipment failure, the system's crossover switching capability allows for the rerouting of the high-priority data circuits to the user's backup equipment.

The LNF-3 costs $2,240. The DPS-5 costs $7,871. Equipped with optional visual and audio LED alarms and LED status indicators, the DPS-5 is priced at $8,935.

Atlantic Research Corp., 5390 Cherokee Ave., Alexandria, Va. 22314.

Easylink Designed For Incompatibles

Western Union Telegraph Co. has announced a communications software program designed to provide instant electronic communications to users of otherwise incompatible personal computers, word processors, terminals and mainframe computers.

The Easylink Instant Mail Manager reportedly provides word processing, data base and disk file management and communications capability in one integrated package. It also provides access to information data base retrieval services and corporate data bases. The software currently runs on the IBM Personal Computer, IBM Personal Computer/XT, IBM Portable and IBM compatibles.

Functions include a text editing program, a display of status indicators including page width and length of file, address data base management and several delivery options, including electronic mail and telex.

The Easylink Instant Mail Manager software sells for $95.

Western Union Telegraph Co., One Lake Street, Upper Saddle River, N.J. 07458.

Mail System Delivers With IBM Micro

New Era Technologies, Inc. announced an integrated electronic mail, computer teleconferencing and bulletin board system for the IBM Personal Computer/XT and compatible hard disk systems.

Conexus offers private mail, group conferencing and keyword-accessible bulletin boards for up to 1,000 users. Users can trace the receipt status of messages and modify sent messages before they have been received.

The system also reportedly offers manager access or the ability to create public or private conferences where several users can carry on group discussions.

Conexus uses PC-DOS or MS-DOS 2.0 on IBM Personal Computer/XT or personal computer compatibles with hard-disk storage and requires 256K bit/sec of random-access memory and the Hayes Microcomputer Products, Inc. Smartmodem 1200, 1200B or 300 if the system is to be accessed via telecommunications.

The system sells for $624.

New Era Technologies, Inc., Suite 922, 2025 I St. N.W., Washington, D.C. 20006.

Ethernet Version Out for Samson Micro

SGS Semiconductor Corp. has unveiled a version of the Xerox Corp. Ethernet local-area network system for its Samson Unix supermicro and an intelligent serial I/O communications controller board that is compatible with Intel Corp.'s Multibus.

The Samson Ethernet system reportedly features both front-end processing and the transmission control protocol/internet protocol and allows a variety of protocol architectures to be used.

The system meets the Ethernet specification Version 1.0 of up to a 10M bit/sec transfer rate and a 16-bit dedicated CPU with 128K bytes of on-board random-access memory for message buffering and high-level protocol software.

Samson Ethernet costs less than $200 per user.

The SAM-ISCC/8 intelligent serial communications controller board is reportedly Multibus-compatible and provides eight identical RS-232-C serial channels that are controlled by a 16-bit microprocessor with on-board random-access and read-only memory.

Asynchronous or synchronous transfer modes are said to be supported by the hardware for all eight channels. The bit/sec rate clock source of each channel is programmable from 50K to 19.2K bit/sec. Each channel's clock source may be either internal (on-board oscillator) or external (selectable by software).

The SAM-ISCC/8 board costs $1,490.

SGS Semiconductor Corp., 1000 E. Bell Road, Phoenix, Ariz. 85022.

Statistical Multiplexer, Modem Introduced For IBM Personal Computers and Compatibles

Anderson Jacobson, Inc. has unveiled a 9,600 bit/sec statistical multiplexer and a modem expansion board for IBM and IBM bus-compatible personal computers.

The Expressway statistical multiplexer reportedly allows from four to 16 remote data terminals to communicate at data rates of up to 9,600 bit/sec concurrently on a single telephone line or data link with a central computer.

The Expressway can buffer data prior to transmission, transmit variable-length data blocks according to the loading on individual channels, check data blocks received on the high-speed line and request retransmission in the event of errors.

The product is expandable in four-channel increments from four to 16 channels for both synchronous and asynchronous applications. The unit is offered in both stand-alone and rack-mount configurations.

The price range for the Expressway is from $1,850 for the four-channel model to $7,200 for the 16-channel model with integral 9,600 bit/sec modem.

The modem, the AJ Connection, operates at data rates of 1,200 bit/sec or up to 300 bit/sec in Bell 212A or Bell 101/113 modes with automatic selection of incoming data rates.

The AJ Connection is full- or half-duplex, manual or automatic, originate or answer modem and features a built-in automatic pulse or tone dialer. Two modular jacks reportedly permit both voice and data communications through one system.

A built-in asynchronous communications adapter on the modem board combines two boards in one expansion slot and allows simultaneous data capture and printing while recording. This adapter is available for an additional $50.

The complete Connection package, which includes the modem board, Crosstalk XVI communications software, Crosstalk users guide, Crosstalk diskette and a hardware reference manual costs $495.

Anderson Jacobson, Inc., 521 Charcot Ave., San Jose, Calif. 95131.

PRODUCTS

Four-Phase Polishes Desktops

Four-Phase Systems, Inc. has announced enhancements to its 2000 family of communicating desktop computers. They include a Motorola, Inc. 68010 processor, a virtual memory version of Unix System V, a high-performance 52M-byte Winchester disk drive that increases on-line storage to 369M bytes and a 5M-byte removable Winchester disk.

The 2000 series features IBM-compatible batch and interactive communications using Systems Network Architecture and Binary Synchronous Communications and asynchronous protocols. It is designed for companies with large data networks that require customer development data processing applications, word processing and spreadsheet analysis at remote office locations, a company spokesman said.

A 2000 Model 240/3 with one workstation, 384K bytes of memory and 20M bytes of Winchester disk storage lists for $8,710. A Model 260/4 with four workstations, a 68010 applications processor, 512K bytes of error-correcting memory, a master I/O controller and 57M bytes of Winchester disk storage costs $20,550.

Four-Phase Systems, Inc., 10700 N. DeAnza Blvd., Cupertino, Calif. 95014.

Loopback Test System Enables Operator to Check Remote Stations

RFL Industries, Inc. has announced a loopback test system that will enable the operator to select from one to 1,000 remote stations and perform up to five tests on transmission lines.

The system consists of a master station — control or central — that uses dual-tone multifrequency signaling and from one to 1,000 remote stations.

The tests include: audio loopback, to determine the frequency response and noise of the transmission lines from the master station to the remote station and back, as well as quiet termination, to disable a troublesome remote station temporarily or to determine the amount of noise from the remote station to the master station.

Other tests include: one-way loss, to determine the one-way loss of transmission lines; digital loopback, to loop a digital interface at the remote station; and amputation disconnect, to disable a troublesome remote station without time limitations.

The price for loopback remote units starts at less than $500.

RFL Industries, Inc., Powerville Road, Boonton, N.J. 07005.

Net Links IBM, DEC and HP On One-Cable Plan

CR Computer Systems, Inc. has announced a local- and wide-area network that allows IBM 3278/3279 display stations, IBM Personal Computers and Digital Equipment Corp. VT-100-compatible terminals to communicate with IBM, DEC and Hewlett-Packard Co. host computers on a one-cable plan.

X-Net, a dual-bus network, also supports 3274 Binary Synchronous Communications and Systems Network Architecture/Synchronous Data Link Control. It reportedly takes care of all protocol conversion, screen format mapping, frame routing and flow control. Up to eight layers of password protection can be implemented, avoiding unauthorized data access.

X-Net also allows up to 2,032 connections per site and is able to interconnect up to 255 sites via X.25 gateways. It also uses a roll-call polling scheme and accommodates data throughput up to 14.75M bit/sec.

The price per connection for X-Net is $1,000.

CR Computer Systems, Inc., Suite 182, 5456 McConnell Ave., Los Angeles, Calif. 90066.

Unit Permits Multiple Use for Analog, DDS

Teleprocessing Products, Inc. has introduced a modem-sharing unit for analog or AT&T's Dataphone Digital Service links that allows one modem or digital service unit to support up to four terminals or control units at scattered locations within the network node.

Designed for desktop use, the TP-2/4 is housed in a metal case and has low heat emission. Data channel indicators and a power indicator are on the front panel of the device.

The TP-2/4 single quantity price is listed at $345.

Teleprocessing Products, Inc., 4565 E. Industrial St., Building 7K, Simi Valley, Calif. 93063.

Whisperlink Transmits To 16,000 Feet

FiberCom, Inc. has announced a fiber-optic local data modem providing full-duplex transmission from 300 to 19.2K bit/sec in either synchronous or asynchronous modes over distances up to 16,000 feet.

Whisperlink reportedly has its own internally generated clock signals for synchronous operation. A variety of RS-232 functions are provided over a single pair of optical fibers.

Selectable clear to send delay times are available for continuous or switched carrier operations, a representative for the company said.

The price for the Whisperlink is $495. Quantity pricing is also available.

FiberCom, Inc., P.O. Box 7317, Roanoke, Va. 24019.

Package Links Services To IBM Compatibles

Softronics, Inc. has announced a software package it claims is able to integrate communications with every IBM Personal Computer-compatible program.

The Softerm PC functions either as a stand-alone program or as an extension to the PC-DOS to let users access communications services while using other programs.

The software can be used to access information services, bulletin boards, electronic mail systems and company mainframes, according to a company spokesman.

It includes emulations of 24 popular terminals and contains features such as a built-in phone book for automatic dialing and simultaneous capture to print or disk.

Softerm PC retails for $295. The price includes a users guide.

Softronics, Inc., Suite 10, 3639 New Getwell Road, Memphis, Tenn. 38118.

Multiplexers Offered For IBM 3274s

Two different versions of a coaxial/fiber-optic multiplexer for IBM 3274 controllers have been announced by Canoga Data Systems, Inc.

The CDX-327 multiplexes up to 32 coaxial cables onto a single coaxial or fiber-optic cable without data speed degradation. The maximum separation of these units is one mile. All have status and fault indicators for each channel, according to a spokesman for the vendor.

The stand-alone version of the unit supports eight coaxially connected terminals on a single cable, while the modular rack-mount unit can be configured to support eight, 16, 24 or 32 monitors and printers attached via coaxial cable, the spokesman said.

The stand-alone unit costs $1,000, while versions of the modular rack-mount unit accommodate eight, 16, 24 or 32 monitors and printers and range in price from $1,975 to $3,275, depending on configuration. A fiber-optic upgrade for the stand-alone unit or any version of the rack-mount unit is available for an additional $525.

Canoga Data Systems, Inc., 21218 Vanowen St., Canoga Park, Calif. 91303.

Bevy of Tools Added To Advanced Network Integration Line

Infotron Systems Corp. has unveiled a voice card for its T-1 multiplexer, a time-division multiplexer, a data private branch exchange (PBX) and an IBM terminal emulation system. All four are part of the vendor's Advanced Network Integration product line.

The dual-channel T-1 multiplexer card reportedly allows the company's bit-interleaved time-division multiplexer to handle digitized voice in addition to data. Each voice channel operates at 32K bit/sec.

The price, per voice card, is $880.

The TL 300 time-division multiplexer can reportedly handle six synchronous input channels. By connecting additional units to the first two channels, the TL 300 can service up to 16 channels at a single site.

Dip switch settings on the front of the unit allow selection of both line rates and channel speeds. The bit-interleaved time-division multiplexer is said to operate at 16K-, 32K-, 48K-, 56K- or 64K bit/sec.

The TL 300 costs $2,700.

The data PBX, dubbed the Contender, can reportedly accommodate up to 500 I/O channels. The Contender 500 provides data PBX contention for limited resources, keyboard selection of various hosts and console control of all network resources.

The Contender 500 costs approximately $60,000.

The Virtual Terminal System 362 enables Ascii terminals, personal computers and other asynchronous devices to work in a synchronous IBM 3270 Systems Network Architecture/Synchronous Data Link Control network.

This terminal emulation system can support one or two host lines that can be either directly connected or connected via dial-up lines. The VTS 362 can support up to 16 asynchronous devices, according to a spokesman for the vendor.

The VTS 362 can be purchased as a stand-alone or rack-mount unit for $9,800. All four products are available immediately.

Infotron Systems Corp., 9 N. Olney Ave., Cherry Hill, N.J. 08003.

Protocol Analyzer Features Remote Control

A protocol analyzer, featuring full remote-control capability, has been announced by Hewlett-Packard Co.

The HP 4953A allows users to monitor data transmission or simulate network components. The unit can monitor bit-oriented protocols at speeds up to 256K bit/sec and provides complete simulation at speeds up to 72K bit/sec without loss of triggering capability.

According to a spokesman for the vendor, in its full remote-control mode, the unit enables the user to give commands to download a test to another HP 4953A, execute the measurements and automatically upload the results from the other unit, even if that unit is unattended.

The product is fully compatible with the vendor's HP 4955A and 4951A protocol analyzers.

The HP 4953A is priced at $12,000. Options for the product include a 256K-byte memory extension for $1,100; a Katakan keyboard for $250; and a series of interface pods — RS-232-C/V.24, RS-449, MIE188C, RS-422 — each priced at $950.

Hewlett-Packard Co., 3000 Hanover St., Palo Alto, Calif. 94304.

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(617) 879-0700, Telex: 95-1153.

Interface Links IBM Micros

The Braegen Corp. has announced an interface board that reportedly provides a direct channel link between IBM Personal Computers and compatibles and as many as 16 local or remotely located host computers on its Elan local-area network.

The Elan/PC allows these units to emulate IBM 3270 terminals. The interface connects directly to the Braegen Elan coaxial network and communicates to any of the vendor's IBM 3270-compatible controllers, according to a vendor spokesman.

The interface board also provides the Personal Computers with multiple application switching and text file transfer, which allows the Personal Computer user to save data received from the mainframe on a floppy disk. All of the units' functions, including color support, are unaffected by the operation of the Elan/PC.

The interface board is priced at $995.

The Braegen Corp., 525 Los Coches St., Milpitas, Calif. 95035.

Queuing Device Offers Autodial

Backus Data Systems, Inc. introduced an automatic port contention and queuing device with an autodial-back feature designed to help solve data security problems.

The Dialcontender verifies telephone numbers called in by customers using a stored directory and passes them to one of the three dialer ports for automatic recall to the user.

A typical seven-port system with a 125 telephone number memory directory sells for $1,295. The standard system is configured for four modems.

Backus Data Systems, Inc., Suite 110, 1440 Koll Circle, San Jose, Calif. 95112.

Transmission Tool Out for Micros

A smart terminal software package that reportedly offers high-speed asynchronous data communications for more than seven systems has been announced by Micro-Systems Software, Inc.

M-Term includes a file-transfer program for error-free binary file transfers among all supported systems. Versions are available for the IBM Personal Computer; the Radio Shack Corp. TRS-80 Models I, III, 4 and 16; the Zenith Data Systems Corp. Z-100; and the Apple Computer, Inc. Apple II.

M-Term handles up to 1,200 bit/sec over dial-up telephone lines and data transmission speeds of up to 9,600 bit/sec on a direct connection between systems. An automatic transmission time feature can automatically dial up and transmit files to a remote computer at a preset time.

M-Term costs $79.95.

Micro-Systems Software, Inc., 4301-18 Oak Circle, Boca Raton, Fla. 33431.

Modem Unveiled For Apple Micro

Microcom, Inc. announced an intelligent 1,200 bit/sec modem and software package available for the Apple Computer, Inc. Macintosh computer.

Called Macmodem, the package includes software, cables and a free subscription to the Dow Jones News Retrieval Service, with one free hour of use. The direct-connect modem supports autodial, autoanswer and is Bell 212A-compatible. Users may upgrade it to 2,400 bit/sec.

Macmodem sells for $699.

Microcom, Inc., 1400A Providence Highway, Norwood, Mass. 02062.

CALENDAR

OCT. 8-10, WASHINGTON, D.C. — *Introduction to Data Communications.* Also, Oct. 10-12, San Francisco; Oct. 15-17; Chicago; Oct. 31-Nov. 2, Raleigh, N.C. Contact: Systems Technology Forum, 9000 Fern Park Drive, Burke, Va. 22015.

OCT. 8-12, ARLINGTON, VA. — *Comprehensive Course in Data Communications.* Contact: Data Communications, Special Projects Conference Management Center, c/o Information Breakthroughs, Inc., 445 W. Main St., Wyckoff, N.J. 07481.

OCT. 8-12, PHOENIX — *DN04 Analysis and Design of Distributed Networks — Part I.* Contact: Ruby Hegarty, Honeywell, Inc., P.O. Box 8000, Mail Station T99, Phoenix, Ariz. 85066.

OCT. 10, TORONTO — *Voice-Data Preview Seminar.* Contact: Angus Telemanagement Group, Suite 210, 2175 Sheppard Ave. E., Toronto, Ont. M2J 1W7.

OCT. 11-12, PHILADELPHIA — *The Information Resource Environment: Micro vs. Mainframe.* Contact: QED Information Sciences, Inc., 170 Linden St., Wellesley, Mass. 02181.

OCT. 11-12, BOSTON — *Effective Presentations.* Contact: QED Information Sciences, Inc., 170 Linden St., Wellesley, Mass. 02181.

OCT. 15-19, TEANECK, N.J. — *Systems Design.* Contact: QED Information Sciences, Inc., 170 Linden St., Wellesley, Mass. 02181.

OCT. 17-19, BOSTON — *Conflict Management.* Contact: QED Information Sciences, Inc., 170 Linden St., Wellesley, Mass. 02181.

OCT. 17-19, SCOTTSDALE, ARIZ. — *Network Communications Protocol.* Also, Oct. 24-26, Detroit; Oct. 31-Nov. 2, Boston. Contact: Center for Advanced Professional Education, Suite 110, 1820 E. Garry St., Santa Ana, Calif. 92705.

OCT. 18-19, WASHINGTON, D.C. — *Data Communications Network Design and Planning.* Also, Oct. 22-23, San Francisco. Contact: Marylou Finer, Probe Research, Inc., P.O. Box 590, Morristown, N.J. 07960.

OCT. 22-23, CHICAGO — *Office Automation Networks.* Contact: Sever Technology, Inc., P.O. Box 50340, Palo Alto, Calif. 94303.

OCT. 22-23, DALLAS — *IMS/VS Concepts and Facilities.* Contact: QED Information Sciences, Inc., 170 Linden St., Wellesley, Mass. 02181.

OCT. 22-24, PHILADELPHIA — *Data Processing Documentation.* Contact: QED Information Sciences, Inc., 170 Linden St., Wellesley, Mass. 02181.

OCT. 22-24, BOSTON — Data Communications Concepts and Systems. Contact: QED Information Sciences, Inc., 170 Linden St., Wellesley, Mass. 02181.

OCT. 22-26, BOSTON — *Systems Analysis.* Contact: QED Information Sciences, Inc., 170 Linden St., Wellesley, Mass. 02181.

OCT. 23-25, BOSTON — *Screen Design.* Contact: QED Information Sciences, Inc., 170 Linden St., Wellesley, Mass. 02181.

OCT. 23-25, WASHINGTON, D.C. — *Selecting a Local-Area Network.* Also, Oct. 30-Nov. 1. Contact: Technology Concepts, Inc., Old County Road, Sudbury, Mass. 01776.

OCT. 24-26, DALLAS — *IMS/VS DL/1 Application Coding.* Contact: QED Information Sciences, Inc., 170 Linden St., Wellesley, Mass. 02181.

OCT. 29-31, BOSTON — *Data Analysis.* Contact QED Information Sciences, Inc., 170 Linden St., Wellesley, Mass. 02181.

OCT. 29-31, ATLANTA — *Data Communications I — Basic Concepts.* Contact: Business Communications Review, 950 York Road, Hinsdale, Ill. 60521.

Barbara Lee Chertok sidesteps seasonal micro mishaps.

Barbara Lee Chertok is an investment manager and coauthor of IBM-PC and XT Owner's Manual, A Practical Guide to Operations *(Robert J. Brady Co., a Prentice-Hall subsidiary, Bowie, Md.).*

My friend, Brian (not his real name), runs a seasonal business. The 10 weeks from the Fourth of July to Labor Day are it. So, imagine his distress when his inventory program, running on his micro, went into limbo halfway through the season. Just as this happened, I arrived for my usual two-week vacation and found a situation that was both maddening and discouraging.

Although he had used computers for his business for several years, Brian was a novice on micros. The store sold him a hard-disk system with MS-DOS and the Micropro International Corp. Wordstar. It had also arranged for someone to write a special inventory program for him. In fact, the programmer was a friend of Brian's. We'll call him Paul.

Paul wrote the program for Brian, but he wrote it to run under CP/M. He gave him two diskettes formatted under CP/M so the system would boot up and run the program. One day, Brian accidentally ran the MS-DOS format program with his CP/M disk in Drive A: His reflexes were quick, but not quick enough. It was disaster time; there was no way to determine how great the disaster was.

You see, the computer salesman had not only neglected to explain to Brian the nature of his microcomputer system, he had also neglected to sell him the necessary CP/M operating system to go with the custom inventory program that Paul had written. Paul knew that Brian only had the MS-DOS operating system, so he had promised to rewrite the inventory program to run under MS-DOS. However, given the pace of life in upper New England in the summer, he just hadn't gotten around to it. C'est la vie!

I was able to clarify the problem, straighten out the mess and get Brian up and running on his microcomputer, but only after several phone calls to the store — the key personnel had all gone fishing — to the regional headquarters and finally to the manufacturer directly. Headquarters had been treating Brian as an unauthorized caller because he was registered as an MS-DOS owner, not as a CP/M owner. After I explained to the manufacturer that the store had erroneously arranged for this custom CP/M program, I did get some useful information. The very next day, everybody from both the local dealer and the regional offices showed up on Brian's front doorstep, full of apologies and offers for further assistance.

The moral of this story is: When in trouble, go to the top.

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